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CIVIL ENGINEERING

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POURING A LARGE SANITARY SEWER IN THE VICINITY OF PHILADELPHIA
Illustrating the Use of Central-Mixed Concrete Deposited Through Chutes

Volume 5 — Number 11

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

NOVEMBER 1935

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Among Our Writers

T. Totake is well known in Japanese engineering circles. For some years he served as chief engineer of the Tokyo Underground Railway Company, and later, during the construction of the subway described in this issue, he acted as consulting engineer for the project.

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Bruce Johnston graduated from the University of Illinois in 1930 with a bachelor's degree in civil engineering. His experience previous to 1931 included work on the construction of the Coolidge Dam in Arizona and some concrete and steel detailing in Chicago. Mr. Johnston received a master's degree at Lehigh University in 1934 after two years as a research fellow. Since that time he has been an instructor in civil engineering at Columbia University.

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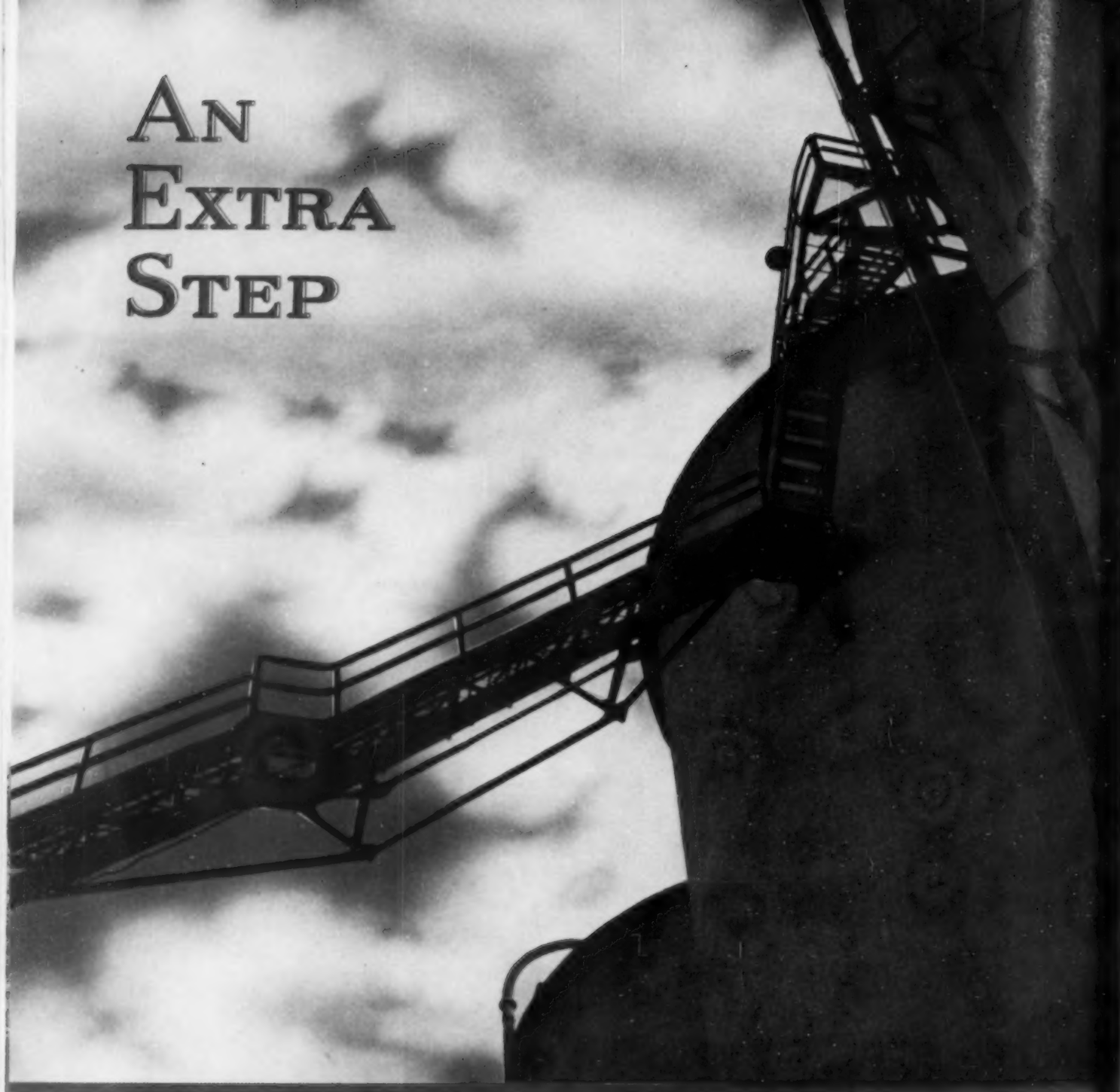

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VOLUME 5

NUMBER 11

The Tokyo Underground Railway

Five Watercourse Crossings Present Problem in Construction of Subway

By T. TOTAKE
CONSULTING ENGINEER, TOKYO UNDERGROUND RAILWAY COMPANY, TOKYO, JAPAN

SINCE 1854, when Commodore Perry of the U. S. Navy succeeded in obtaining the assent of the emperor to a treaty opening certain Japanese ports to American commerce, Japan has entered into trade relations with all of the Occidental peoples. The progressive Japanese nation has always shown a readiness to adopt the newest western scientific developments, and this is nowhere better illustrated than in the field of transportation. Construction of the first high-speed transit rail subway in Japan was undertaken in the city of Tokyo in 1925 by the Tokyo Underground Railway Company, a private organization. At the present time five miles of this two-track line is in successful operation, and work is progressing on additional sections totaling eight miles in length. This article by Mr. Totake gives an interesting account of the methods employed in excavating for the route through the low-lying areas of the city.

TOKYO, capital of the Empire of Japan, lies at the head of the bay of the same name on the southeast coast of Honshu, the principal island. The city stands on the banks of the Sumida River and is the center of a metropolitan area of about 5,000,000 inhabitants. Fifty miles of high-speed rapid transit subway railway is planned for the city. Of this total, the Tokyo Underground Railroad Company has undertaken to design and construct approximately 13 miles (shown in heavy lines on the map, Fig. 1) extending within the city from Asakusa on the north to Magome on the south, with a branch to Shinagawa on the Tokaido railroad to Yokohama. The route passes through the heart of Tokyo, intersecting the principal streets and connecting with the government's existing elevated electric line encircling the inner part of the city.

This paper is concerned with the northern section of the Tokyo Underground Railway Company's line, from Asakusa to Shinbashi, which is the only part as yet in operation (May 1935). A new organization, known as the Tokyo Rapid Transit Railway Company, was established in 1934 and is now making preparations to start construction on another part of the proposed routes.

The story of the Tokyo subway goes back a score of years, to 1914, when the horse and buggy were still in use although fast disappearing before the automobile. At that time Mr. T. Hayakawa, present managing director of the Tokyo Underground Railway Company, visited New York and London as a young man to study street railway transportation. He observed that pedestrian and motor traffic was increasing so rapidly that a serious problem of congestion was bound to result, threatening life and property. He inspected the New York subway system and the London tube, and it became his ambition to build a subway in Tokyo.

At first his idea was scoffed at by experts, but while keenly disappointed he was not discouraged. He finally succeeded in securing financial backing for his project. As a result the Tokyo Underground Railway Company was incorporated in 1918 with a capital of forty million yen (approximately $20,000,000).

ENTRANCE AND EXIT, TOKYO SUBWAY

The type of construction used in the Tokyo subway was modeled for the most part on that developed in New York, which is simple and economical compared to the methods followed in the building of the London tube. Also, the advisers and consultants on the work have been largely American engineers, among them Robert Ridgway, Past-President Am. Soc. C.E. Great difficulties were encountered in the early days of subway construction in New York, but we in this country were fortunate in that we could profit by intercourse across the Pacific, first established by American advice.

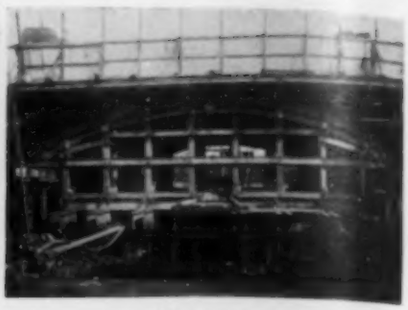
Preparations for starting the construction work were already under way when the great earthquake and fire of 1923 occurred, effectually stopping it. Bearing in mind the destruction wrought by this earthquake and the fact that the subway would

JUST UNDER THE SURFACE, SUBWAY EXCAVATION

"Soldier" Beams Were Driven in Advance of Excavation, as in the Latest American Practice. Middle Line Appears Here

FLUME IN PLACE, KANDA RIVER CROSSING

Stream Flow Was Carried in a Steel Trough Flanked by Cofferdams During Subway Construction



TEMPORARY SHORING, KYOBASHI CANAL BRIDGE

This Steel Arch Bridge Was Supported on Transverse Rows of Sheet Piling Inclosing Subway Excavation

be located largely in wet clay and sand, the structure was designed to resist possible earth movements. Construction was reopened at the northern end in 1925.

GENERAL DESIGN FEATURES

The subway structure is of the two-track box type, of reinforced concrete, both with and without steel frame, and designed to be earthquake-proof. Like the New York subway, it is as near the street surface as possible. The structure is waterproofed on the outside by the use of asphalt-impregnated fabric coated with asphalt. For ventilation, openings covered by steel gratings are provided in the sidewalks. Circulation of air depends upon the piston action of the trains.

Stations are spaced about a half-mile apart. Depths from the street to the platform level never exceed 30 ft. At some stations escalators are provided for the use of passengers, in addition to stairs. Station platforms are of both the island and side platform types, and are 300 ft long. Entrances and exits are generally in the sidewalk, and some are utilized as underground pedestrian passageways to avoid crossing of streets at the surface level.

The track gage is standard, 4 ft $8^1/_2$ in., with 100-lb rail. On one side of the track, an upper contact type of third rail is installed to carry direct current at 600 v. Tracks generally have a concrete bed, although some ballasted track was used. The minimum radius of track curvature is 300 ft, which, however, is used rarely. The maximum grade is 2.5 per cent.

Block signaling apparatus installed in the side walls operates the automatic train stops. Crossovers are provided at terminal stations with electrically operated switches. Although the trains are now operated on a $2^1/_2$-min headway, all operating equipment is designed for a minimum headway of 90 sec.

The subway cars are of the all-steel, bogie type, 50 ft

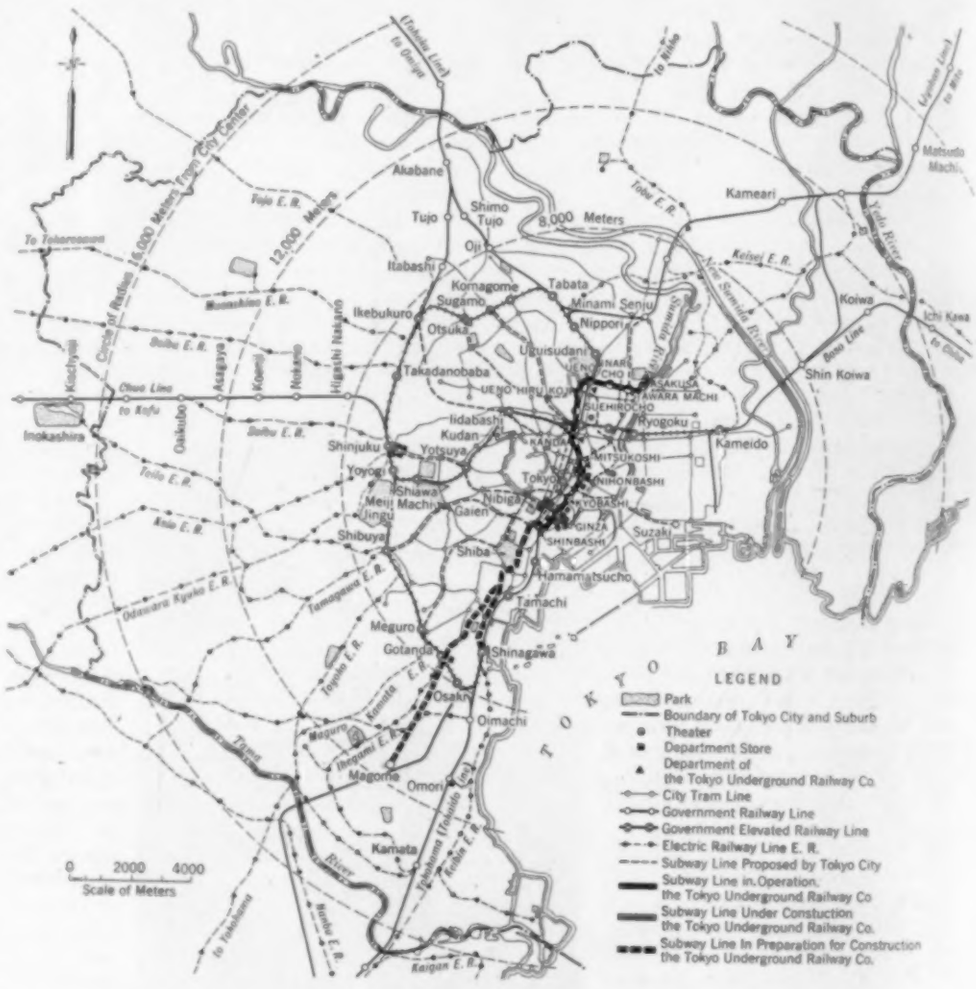


FIG. 1. SKETCH MAP, CITY OF TOKYO

Showing Transportation Facilities. The Tokyo Underground Railway Company's Subway Projects Are Indicated by Heavy Lines

long and 8 ft 6 in. wide, each powered with two 120-hp motors and equipped with mechanically operated doors. There is a car yard and repair shop at the surface level near the Ueno station, connected with the subway by a single-track tunnel. When the subway is extended as proposed, the main car yard and repair shops are to be constructed at the southern terminus of the line.

Electric substations of the remote-control type are provided along the route at intervals of not less than one mile. These are mainly below the street level, utilizing the mezzanine floor of the subway.

In the five miles of subway now in operation there are 12 stations, some of which have several connections. The Asakusa station is connected with the Tobu electric railway running to Nikko, and the Ueno station with the station of the same name on the government railway. The latter is the terminus for the railroad to the eastern and northern parts of the island and is also a way station on the government's elevated electric railway encircling the inner part of the city. The Kanda and Shinbashi subway stations also connect with the elevated railway at stations of the same name.

An important feature of the subway is that it links together six of the largest department stores in Tokyo. The basements of these stores are connected with the mezzanine floor of the subway stations so that the shopping public can move about in comfort, protected from summer heat and showers and from winter cold.

LATEST PRACTICE FOLLOWED IN SHEETING EXCAVATION

The cut-and-cover method of construction was used wherever possible throughout the work. Before excavation was started, soldier beams consisting of steel I-beams 12, 15, or 18 in. in height were driven on both sides of the proposed excavation at intervals of from 3 to 5 ft. Horizontal, longitudinal channels were attached to the top of the soldier beams to support the I-beam girders, 18 or 24 in. in height, spaced transversely at intervals of 5 ft to carry the wood roadway decking. Excavating was carried on beneath the decking, the earth being lifted out by means of skips. Horizontal wooden sheeting was inserted in back of the soldier beams as the depth of excavation increased, and 12-in. diameter timber struts were set transversely to brace the soldier beams.

CROSSOVER NO. 8, TOKYO SUBWAY

Subsurface pipes and ducts were suspended from the girders during the progress of the work below the deck. After the subway structure was completed, the excavation was backfilled; the deck girders were removed; and the soldier beams were pulled for further use. After the customary period required for settling the fill, permanent street paving was laid.

THE KANDA RIVER CROSSING

Between Asakusa and Shinbashi unusual difficulties were encountered, as one river and four canals had to be tunneled under. These were the Kanda River and the Ryukan, Nihonbashi, Kyobashi, an Shinbashi canals. The Kanda River, where the subway tunnel passes under it, is 90 ft wide. Here the tunnel was built directly under an arched masonry highway bridge at the same time that the damage to the bridge caused by the recent earthquake was being repaired.

First, two lines of sheet piling were driven to streambed level directly across the river. At the center of the river a steel trough or flume 20 ft wide, 60 ft long, and 11 ft high was lowered to the river bed, where it rested upon the sheet piling at both ends. Cofferdams were then constructed to shut off the water except in the center where it entered the flume. In this way both river flow and river traffic were satisfactorily maintained. One of the photographs shows a barge passing through the flume. The bed of the river is composed of hard clay with an occasional layer of sand, so that there was no great difficulty in setting the trough and excavating beneath it. When the subway structure was completed, it served as the abutments for an 80-ft flat-arched highway bridge across the river.

ISLAND PLATFORM, GINZA STATION, TOKYO SUBWAY

CONSTRUCTING THE SUBWAY UNDER CANALS

The Ryukan canal is a small waterway 15 ft in width. Here the site of the subway was occupied by a plate-girder highway bridge. The first operation consisted in demolishing parts of the bridge abutments and deck along the sides of the proposed tunnel to make way for two lines of steel sheet piling. On the top of the piling, in the center and near the ends of the bridge girders, temporary transverse supports were erected to pick up the girders. The abutments were then demolished and the subway constructed in open cut. The top of the finished structure is a little lower than the canal bed. When this section of the subway was completed, the foundations for the bridge abutments were built upon it as previously described for similar cases.

The highway bridge over the 180-ft Nihonbashi canal is a masonry structure with two flat arches of 70-ft span. In order to avoid damage to the bridge the subway was re-aligned so as to bring it alongside the bridge instead of under it. Cofferdams were constructed some distance upstream and downstream from the subway crossing and the water diverted to another canal. Sheet piling was then driven on each side of the proposed subway, which was thus constructed in the dry. As the pier and abutments rested upon hard clay covered with a thin layer of sand, the bridge was not damaged.

At the Kyobashi canal crossing, there was a flat two-hinged steel-rib arch bridge of 43-ft span. Here the subsoil was of hard clay so that it was possible to carry the subway excavation directly under the bridge and to pick up the bridge abutments on the completed structure.

TEMPORARY FOOTBRIDGE, SHINBASHI CANAL CROSSING
Here the Subway Interfered Only with the Near Sidewalk and Abutments of the Flat Arched Highway Bridge

KIKUYABASHI THREE-SECTION INVERTED SIPHON
Showing Method of Operating Emergency Slide Gates Provided for Cleaning Purposes

BLOCK SIGNALING APPARATUS WITH AUTOMATIC TRAIN STOPS INSTALLED
The Photograph Shows One of the All-Concrete Sections of the Subway

UENO HIROKOZI STATION MEZZANINE IS ATTRACTIVELY TREATED
Marble Finish Was Employed on Columns, and Ceilings Were Paneled

SCENE AT GINZA STATION ON DAY OF OPENING
Cherry Blossoms Were Included in the Decorations When Subway Operation Was Begun

LARGE NUMBERS RIDE IN THE TOKYO UNDERGROUND SUBWAY
Scene on Mezzanine Floor, Mitsukoshimae Station, Showing Escalator and Stairway

At the steel arch bridge crossing the Nihonbashi canal, the waterway was closed by cofferdams. Sufficient demolition was carried on to permit driving a row of sheet piling along one side of the subway, but the other row was driven outside the bridge. The bridge ribs, spaced 6 ft on centers, were supported by a wood framework and a grillage of steel beams resting on the sheet piling. The subway was then constructed and abutments restored as described for similar cases.

The subway passes under the Shinbashi canal, 80 ft wide, without interfering with the highway bridge, except for one sidewalk, which it underlies. This bridge is a flat reinforced arch supported on abutments resting on hard clay. As it was possible here also to divert the water, full-width cofferdams were built. A wooden footbridge 10 ft wide was built close to the old bridge and the sidewalk of the latter was demolished together with parts of the abutments. Two rows of sheet piles were driven, and excavation and construction were carried out as previously described at other sites.

UNDERPINNING BUILDINGS AND ELEVATED RAILWAY

Between Shinbashi bridge and Shinbashi station the subway curves around a street corner. Half the width of the subway lies just under three two-story frame buildings, which had been built following the 1923 earthquake and fires. In constructing the subway under these buildings the following method was used. First, two rows of soldier beams were driven, one along the outside of the subway, the other along the front of the shop buildings. Excavation outside the buildings was then carried down almost to the depth of the subway roof, and 20-in. I-beams were driven horizontally into the side of the trench just below the buildings at intervals of 3.3 ft. This was accomplished by boring 8-in. diameter holes and inserting 9-ft lengths of beam by the use of a hydraulic ram, adding lengths as required. The near ends of the horizontal beams were connected to the soldier beams, thus supporting the load of the buildings and the earth above the horizontal beams. Excavation was then carried on beneath the buildings, using wood sheeting on the lower flanges of the horizontal beams and the vertical faces of the excavation. In this way an excavation was completed 47 ft deep and 20 ft wide outside the buildings, and 27 ft high and 17 ft wide under the buildings. The subway was then constructed with steel side-wall and center columns spaced at 3.3-ft intervals, designed to carry a concrete building up to eight stories in height. The work was conducted without serious damage to the buildings, as the soil was a hard clay with a thin layer of sand carrying only a small amount of water.

At Sudacho and Kanda the subway passes under the elevated railway close to a number of its piers, which rest on a shallow foundation. In order to avoid possible settlement of the piers, I-beam piles were driven adjacent to them and the load of the railway girders picked up on grillages and timber bents supported on the piles until the subway work could be completed and solid foundations provided for the piers.

INVERTED SIPHON CONSTRUCTED FOR KIKUYABASHI SEWER

The Kikuyabashi area is composed of sediments recently deposited, and here many difficulties were encountered. The mud proved to be so soft that the soldier beams could be driven with only a few strokes of the hammer, and some piles went through 10 ft or more of material at one hammer stroke. Here a concrete sewer 6 ft in diameter was encountered, directly across the line of the work. It was necessary to replace this sewer with an inverted siphon passing under the subway. The siphon consisted of three steel pipes encased in concrete, one pipe 2 ft in diameter at the bottom for ordinary use and two pipes above, each 3 ft in diameter, for flood discharges. At each end of each pipe, gates were provided for cleaning purposes. Where it crosses over the siphon, the subway is supported on independent pile foundations so as to avoid damaging the siphon in the event of relative displacement of the structures.

DRIVING NEEDLE BEAM WITH HYDRAULIC RAM

The Hard Clay Underlying the Frame Buildings Made It Possible to Underpin Simply by Driving in Horizontal Beams and Supporting the Soil on Wood Sheeting

NEW ROAD TUNNELING BY DRIVING HEADINGS

A part of the subway line between the Kanda River and the Kanda station had been designed to pass in tunnel under private land on which stood houses built before the 1923 earthquake and the fires. In the course of the work of restoration a new road was laid out along the proposed route and all houses were demolished before the subway work was begun. But to avoid tearing up the new paving, a circular double-track tunnel, 440 ft long and with 20 ft of cover, was constructed under the road in accordance with the first design.

The excavation and timbering system used in ordinary rock tunneling was felt to be unsuitable, on account of the danger of road settlement, and it was decided to drive individual headings for the various parts of the structure. Two vertical shafts were sunk, one on each side of the road, with sumps at the bottom to lower the ground-water level. Headings for the lower side walls were first driven and filled with concrete. Then came headings for the next higher section of the walls, and this was repeated until, after nine headings and nine concretings, the side walls and arch of the tunnel were completed. Concrete was placed in confined quarters by pumping through pipes. The central core was then excavated and the invert concreted. Cement grout was applied to the side wall and arch for waterproofing purposes, and the invert was protected by a layer of asphalt fabric.

The construction work in general progressed smoothly, so that the section from Asakusa to Ueno was put in operation in 1927. The public, which had been critical, was favorably impressed by this achievement. Thus encouraged, those in charge of the work redoubled their efforts and the line was extended to Shinbashi station. The total length of the double-track line now in operation (May 1935) is five miles.

Production of Central-Mixed Concrete

Some Features of a Growing Industry in Philadelphia and Environs

By HERBERT J. KNOPEL
CONSULTING ENGINEER, PHILADELPHIA, PA.

AS a result of the modern method of specifying concrete on the basis of strength, the past decade has witnessed the springing up at many points of central plants equipped to furnish properly proportioned ready-mixed concrete directly on the job. The central plant operator guarantees that the concrete will be of the strength specified, and seeks to make good this guarantee at a reasonable profit by his knowledge and skill in economical production. In this article Mr. Knopel first traces the development of the ready-mixed concrete industry in the Philadelphia area. He then takes up the advantages claimed for central-mixed concrete, resting his argument principally upon superior equipment for accurate proportioning, operated under the direct engineering supervision which is customary among the large central producers. This article was prepared from an address made by Mr. Knopel on May 15, 1935, before the Philadelphia Section of the Society.

FOR a long time makers of concrete struggled against rather poor precedents. But it is not surprising that the mass use of concrete during the past decade engendered a hearty response to the idea of central mixing which guaranteed the precision weighing of ingredients and adjustments for such conditions as result from the bulking action of sand, a wide range in moisture content in the aggregate, and variation in grading. In 1925 there were 25 central mixing plants in existence. Today there are more than a hundred scattered throughout the country, principally in the larger cities.

The first plant in Philadelphia began operations in March 1921, originally for the supply of street paving concrete exclusively. Concrete was transported in watertight, open, fishtail dump bodies. This type of vehicle did not lend itself to the transportation of any but comparatively dry mixes, and opportunity was afforded to study and learn from practical experience some of the causes of segregation, separation, and "packing." Continued investigation brought to light the more definite and important recognition of aggregate grading combinations.

About 1928 Duff Abrams and Franklin R. McMillan, Members Am. Soc. C.E., both outstanding in the field of concrete research, through intensive study and a series of tests conducted in collaboration with twenty nationally known laboratories, firmly established two outstanding principles applying to concrete mixtures. They are the water-cement ratio law and the effects of longer mixing. The water-cement ratio law made it possible to forecast by design the compressive strength of concrete, and the longer mixing period demonstrated the beneficial effects of the early intimate contact of water on the action of cement.

In 1929 many engineers, architects, various municipal bureaus, and other governmental bodies, after investigating these principles and becoming more familiar with them, discarded the old idea that concrete had to be placed immediately after it was mixed. The series of demonstrations and tests which followed revealed that transportation in agitating trucks increased the plasticity of the concrete, and that cylinders taken at the job were stronger in compression than those taken at the plant. The consensus of opinion is that this improvement in strength is attributable to increased colloidal properties produced in the cementing material in the early stages of hydration.

Then followed the inclusion of clauses by the various Philadelphia bureaus, permitting the use of ready-mixed concrete, so that in 1929 the production grew to over 175,000 cu yd. This concrete was supplied for foundation work; for retaining walls; for the superstructure of office buildings, apartments, schools, hotels, and factory units; and for a large amount of paving work. During the past seven years over 2,000,000 cu yd of ready-mixed concrete have been sold and delivered in the Philadelphia area. Today the plants also supply a sizable amount for state highway construction. Plants producing central-mixed concrete in the city of Philadelphia have a combined capacity of 3,500 cu yd per day; those in Wilmington and Trenton each have a capacity of about 600 cu yd per day.

Some idea of the magnitude of the investment in land and in plants required for the production, classification, and conditioning of this volume of concrete aggregate may be obtained by considering that when there is a good demand, the dredging operations will pump a volume of water every 24 hours sufficient to supply the normal requirements of a city of 300,000 population.

ADVANTAGES OF CENTRAL MIXING

The term "ready-mixed concrete" should not imply that the product is a trade name or mark for higher quality than can be produced elsewhere. Rather, it has as its background the inference that the product comes from fabricating plants that possess the proper mechanized control and proper servicing equipment.

It would be unfair to assert that by using central-

GRADE SEPARATION AT SWARTHMORE, PA.
Concrete Road Being Constructed Under the Pennsylvania Railroad

mixed concrete a better finished job will be secured than can be produced by a contractor who has acquired the requisite knowledge and skill to properly mix concrete in the field, for the final result involves the three operations of making, placing, and curing. It is fair to state, however, that for economic reasons, seldom, except on the large jobs, are plant, equipment, and technical operative forces adequate to produce job-mixed concrete of comparable quality.

The chief advantage of central-mixed concrete to a community is the availability of a permanent organization sufficiently large to provide adequate facilities for proper storage and classification of aggregates, for accurate batching by weight, for regulation of temperature, for control of the water-cement ratio, and for the longer intimate contact of mixing water and cement with thorough incorporation of the ingredients. Central-mixed concrete has certain outstanding features. On account of the longer mixing period, added cohesiveness results. Tests of plasticity indicate thorough lubrication of the mass. Concrete foremen have remarked about the ease of spreading. Cement finishers have said that central-mixed concrete possesses the cohesiveness desired for finishing. The advantages of being able to start concreting at any time of the day, for any size of pour, have been noticeable. This latter feature minimizes the standby charge of labor and machinery.

I believe the well-organized central-mixed-concrete plants have established a unique place in assuring economical maintenance of high standards. Central mixing insures uniform quality of concrete through proper mechanical control of its fabrication. This in turn makes it possible to utilize the higher stresses permissible under present building codes.

Purchasers have claimed other advantages, such as the saving of storage space and care of materials; the fact that their concrete plant and appurtenances can be dispensed with; the safeguard that is provided in cleanness and in doing away with losses of cement and aggregates; the assurance of a guaranteed strength

STREET CAVE-IN CAUSED BY SEWER BREAK
Scene at 43d and Walnut Streets, Philadelphia, During Repair Work

and quality; and protection against the frequent breakdowns of job plants.

The agitator type of truck ensures transportation of the mixed concrete over relatively long distances without segregation of the materials and facilitates discharge at the job. In general, the agitating trucks used by responsible distributors are relatively costly units, which are well serviced and maintained by a garage staff of mechanics. They are, therefore, more likely to be in good physical and mechanical condition than many of the mixers in general use.

It must be remembered that when central-mixed concrete was put on the market the merits of the product had to be endorsed by owner, architect, engineer, contractor, and financial interests. That such endorsement was obtained is indicated by the growth of the new industry as shown in terms of volume of sales, cited elsewhere in this article. Personally, I believe that the confidence in this product was born of the assurance that its producers had acquired a definite knowledge of its manufacture and possessed the means of more satisfactory technical control of the materials.

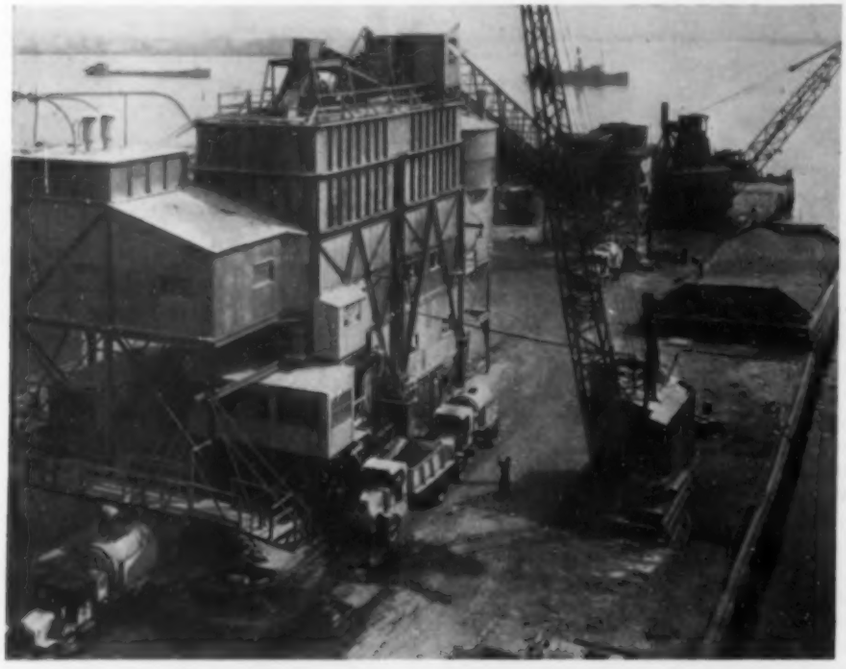
POURING CONCRETE IN THE CONGESTED BUSINESS SECTION OF A LARGE CITY
An Illustration of the Limited Space Sometimes Available for a Contractor's Plant. The Circle in the Center of the Photograph Indicates a Central-Mix Delivery Truck

FACTORS IN THE DETERMINATION OF PRICES

It is pertinent here to compare the relative costs of central-mixed and job-mixed concrete. I will mention four price-making axioms:

1. Concrete is unique because it cannot be manufactured in advance and stored, yet it must be immediately available when needed.

2. Prices for concrete cannot be greater than the value of the product to the purchaser. (Here it is necessary to agree upon a qualifying clause as to value.)
3. Prices must be such as will hold business in competition with products that may be substituted.
4. Stabilized prices based on sound practices are usually a prerequisite to a profit.



GENERAL VIEW OF MODERN CENTRAL-MIXED-CONCRETE PLANT AT PHILADELPHIA, PA. In the Right Background, a Clamshell Bucket Is Unloading Aggregate from the Barge to the Wharf Storage Bins, Whence It Is Carried by a Conveyor to Aggregate Bins in the Top Center. Cement Is Pumped in Through the Pipes at the Extreme Top Left. The Batchers Are Located in the Second Story of the Structure with the Mixers Directly Below. Continuity of Deliveries Is Assured by Large Storage Facilities. The Principal Features of the Photograph Are Shown Diagrammatically in Fig. 1

The cost to the contractor, delivered, of central-mixed concrete in Philadelphia is based on the price of cement, sand, and gravel or stone at the material dealers' schedule of retail delivery prices, plus an added differential to cover the costs assumed by the producer of the central-mixed concrete, from which the contractor is relieved.

Approaching the matter as a construction engineer, it is my opinion that in fixing this differential the following costs and contingencies inherent in job plants should be taken into account: Cost of storage, labor, and material for water lines, of cement and aggregate lost at the building site, and of possibility of breakdown of mixer, and extra labor on account of decreased workability; cost of certification, engineering control, and test data; saving by increase in delivered yardage per hour over job mix; cost of mixer and appurtenances; saving in rehandling of building materials, in the cost of direct placing, heating of materials, and labor standby.

GENERAL ARRANGEMENT OF A CENTRAL PLANT

A plan and elevation showing the layout of a typical central-mixed-concrete plant appears in Fig. 1. As shown at the right in this diagram, a revolving crane or stiff-leg derrick is used to unload the sand and gravel from barges or gondola cars. Ground storage of these materials in quantity is desirable to assure uninterrupted service during periods of peak production. This ground storage should be quickly accessible by some means, such as that shown in Fig. 1, where a conveyor operates in a tunnel below ground. Overhead storage of aggregate is limited by the expense of suitable structures, but should be sufficient for a run of at least several hours of the plant. This is useful in emergency. In the event of a breakdown of cranes or conveyors, ample time is provided for repairs, and this precautionary measure ensures uninterrupted service to the job.

As shown at the left in Fig. 1, the cement is received in bulk in hopper-bottom cars, unloaded by means of a screw conveyor, and delivered by a cement pump to an elevated tank near the mixers. A cement silo provides for storage in quantity. The usual type of conveyor system is a combination of compressed air and screw conveyor, which keeps the cement in a fluffed condition, prevents packing tendencies, and distributes the cement in the mixer at a more rapid rate than is possible when the cement is bagged.

The mixers are located directly below the overhead aggregate bins, and the charge is weighed out in batchers. The cement batcher is fed by a screw conveyor from the elevated cement bins. Water is supplied from measuring tanks located conveniently above the mixers. From the mixers, the concrete is discharged directly into a revolving truck which agitates the charge while en route to the job.

Above each mixer at the plant there are four separate compartments for the handling of different brands of cement. In practice interested purchasing parties are generally satisfied if the plant

OPERATOR'S PLATFORM FOR PROPORTIONING AND MIXING, IN A MODERN CENTRAL-MIXED-CONCRETE PLANT

The Weight of the Materials Deposited in the Batcher Registers Automatically on an Illuminated Dial in the Mechanism at the Left, Within an Accuracy of 2 Lb for Cement and 10 Lb for Aggregates. Mixing Water Is Metered from Tanks with an Accuracy of 1/4 Gal. The Supervising Engineer Maintains Constant Control at the Plant

takes in the full amount of cement required on those jobs for which specific brands are requested, without insisting upon the use of the specified brand for that particular operation. Obviously it is difficult to have readily available 15 different brands of cement and try to keep them in step when there are 40 or 50 trucks going to different jobs with different mixes. However, the producer has become accustomed to the requirements of some owners who insist upon sealed cement bins.

Usually the exceptions can be taken care of, provided that too many insisting upon this arrangement do not come into the market simultaneously. Some time ago a question arose in certain avenues of trade about the mixing of two brands of cement in the general run of the day's work. Representatives of an organization collaborating with cement companies have demonstrated that this should make no difference with the present-day brands of portland cement, provided the physical and chemical characteristics of the two cements are similar. The producer, being familiar with cement brands from the various mills, guards against mixing two cements of dissimilar characteristics.

Temperature control of concrete is most important. The engineer operative at the plant must have information concerning job conditions, for obviously a temperature of 70 F might be desirable if the concrete were to be placed in a heated building, whereas from 85 to 90 F might be more appropriate for outside construction. The latter would be manifestly wrong for an inside job and might result in too rapid drying out of the concrete, with a weaker structure resulting.

In preparation for the winter demand for heated concrete, live-steam jets are put in service at the bin discharge gates. Only sufficient live steam is used to break up frozen lumps, thus avoiding the saturation of aggregates which would result if live steam were used throughout the aggregate bins.

Heating the mixing water is found to be the most satisfactory method for temperature control of the concrete. Overhead hot-water storage tanks are in general use. A thermostatic valve-control admits sufficient cold water to regulate the temperature of the water reaching the mixer.

Sufficient boiler capacity is generally made available to heat a maximum of 100 cu yd per hr to a minimum temperature of 70 F, with atmospheric temperature as low as zero. However, a sustained water temperature of 140 to 180 F will usually produce satisfactory results.

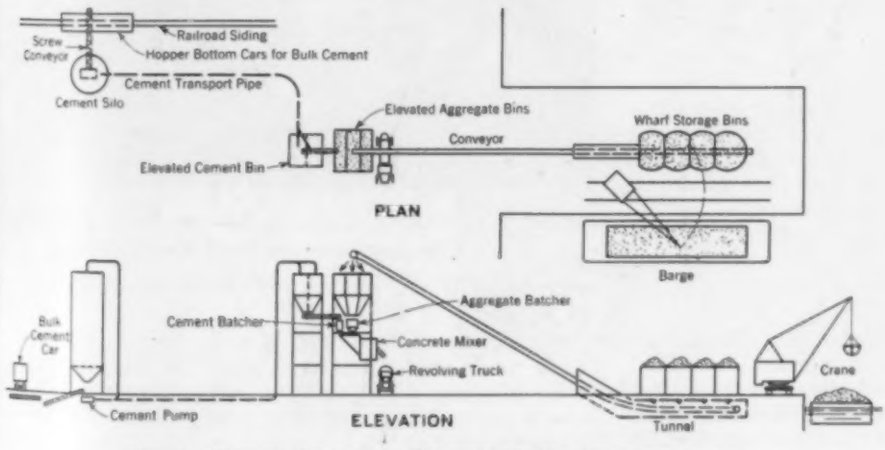


FIG. 1. TYPICAL LAYOUT OF CENTRAL-MIXED-CONCRETE PLANT
Aggregates Are Shown Flowing in from the Right, Cement from the Left

Concrete producers employ in their distributing organizations district street superintendents. These superintendents act as liaison men between the job, the sales department, and the order department, and advise on the movement of trucks, the timing of delivery, and the rate of delivery of concrete. This is an economic function, its object being to sustain a proper cost differential previously mentioned, and to keep the range of prices attractive to the purchaser.

CENTRAL-MIX TRUCK DRIVES DIRECTLY INTO BUILDING UNDER CONSTRUCTION
By Pouring Directly Into the Forms, the Truck Eliminates Rehandling and Promotes Uniformity in Concrete

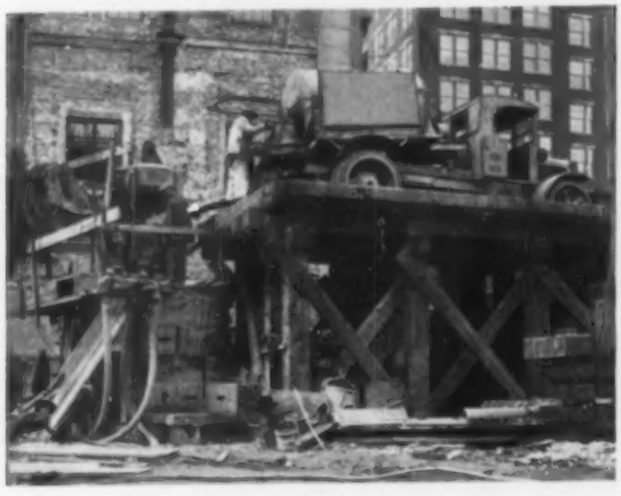
DISTRIBUTION AND TECHNICAL CONTROL OF OUTPUT

As soon as a new job is scheduled for delivery of concrete, the street superintendent visits the site and confers with the construction superintendent to arrange an efficient and mutually economical setup for handling the concrete. My experience has been that the most economical arrangement for both parties is a suitable relay hopper at the site which will hold an ample supply up to 3 or 4 cu yd. This reduces costs, acts as an incentive to speed the operation of placing, and makes for better timing of the cycle of deliveries. The job relay hopper is unnecessary where further economy can be secured by placing direct, through chute or tremie. An important feature at the job is proper means of ingress and egress for the trucks to and from strategic points of the work.

Central-mixed-concrete plants in Philadelphia employ separate and distinct engineering supervision, under the full authority of independent consulting engineers. Under this supervision, engineer operatives are stationed at each plant, and their duties are to see that every batch is fabricated in accordance with the customer's order and the specifications in force. Philadelphia producers do not regard this plant supervision and control as perfunctory, but hold it strictly accountable for rigid control practices and for

satisfactory results on all classes of work. Such engineering supervision and control is in conformity with the building codes and other regulations.

This engineering technical service cooperates with the engineering department of the producer, and constantly investigates all avenues of research pertaining to the industry, so that, given correctly designed mixes based upon the known characteristics of grading and physical characteristics of the fine and coarse aggregates available, the quality of the concrete is assured.



POURING CENTRAL-MIXED CONCRETE INTO A PNEUMATIC CAISSON FOR AN OFFICE BUILDING

Lack of Space Adjacent to Site of New Building Fails to Hinder Concrete Work

Representatives of the purchasers of concrete at all times have free access to the plant and its records, and contact with the engineer operative at the plant. Every car of cement received is inspected and tested at the cement mills by resident inspectors, affiliated either with some local bureau or with the independent engineering service. An interesting feature of this service is the checking of the cement temperature at the loading point, as it has been found that extremely hot cement will upset the water calculation in the process of securing desired consistency. This has led to the establishment at the mill of a maximum temperature of 140 F on all shipments.

It should be emphasized that those using central-mixed concrete should see to it that all the information is gotten through to the producer, for by cooperation between the purchaser and the supplier, satisfaction can be assured.

Each mixing plant is equipped with a field laboratory for making the necessary tests. A record is kept of the grading tolerances and the fineness modulus of the fine and coarse aggregates. Frequent tests are made to determine the amount of the contained water in the aggregate, which may vary between 5 and 12 gal for $1\frac{3}{4}$ tons of aggregate, which is the approximate amount of combined aggregates necessary to produce a cubic yard of concrete.

The plants are equipped with means for quickly securing the data for making adjustments. Periodical tests to determine moisture content are made by means of a hot plate. On the mixer turret these determinations can be made in 3 min by the use of the Chapman flask.

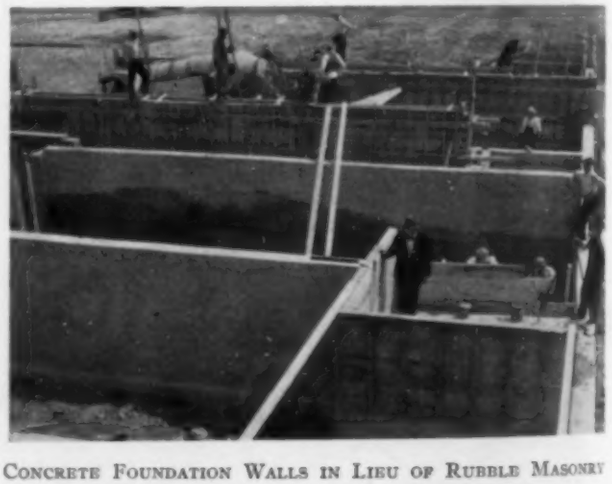
Each day a number of routine tests are made of the mixes going to the jobs. The engineer operative has full knowledge of the analyses of the different mixes he is furnishing, and the producer is also advised of the results of the tests. When the bulking of sand and coarse aggregate may range from 12 to 25 per cent, due to moisture content, and when the contained water may range from 2 to 8 per cent by weight, the amount of water to be added at the mixer obviously cannot be determined by guesswork.

On arrival of aggregates either by boatload or carload, the testing engineer checks the source of supply and sees that all ingredients meet the local standards and those of the American Society for Testing Materials for grading tolerances, cleanness, and absence of organic matter.

A "commercial" graded aggregate has certain tolerances in terms of percentages passing or retained on standard sieves and screens. These tolerances permit of variations on a given sieve or screen of 10 per cent either way from an average grading produced, and adjustments are made to overcome oversanding of the mix on the one hand or harshness on the other.

Fineness modulus determinations are made, and these permit rapid adjustment of the ratio of fine to coarse aggregate. This is essential to the control of consistency and workability, to the observance of the prescribed tolerances of the water-cement ratio, and to the maintenance of a constant total quantity of water per batch.

The weights for aggregates used in all mixes are in terms of sand containing 4 per cent moisture and gravel containing 1 per cent moisture. This amount has been found normal for nine months of the year. Any increase above these limits is immediately compensated for by the addition of sand or gravel. The actual amount of the contained water in a given quantity of aggregate is found by standard test methods and charts. This amount, plus the added water, equals the total water, and must be within the limitation of the governing water-cement ratio, and must also correspond with the desired quality and quantity of the cement paste for the mix in course of fabrication.



CONCRETE FOUNDATION WALLS IN LIEU OF RUBBLE MASONRY

Used for Row Houses in South Philadelphia

A record is kept by the engineer operative of every batch made and discharged into the delivery truck. While as many as 25 different mixes may be sent out from a plant during one day, this system of recording batches with the truck number and the job is so well keyed that sending a wrong mix or wrong consistency to a job is practically impossible.

New Jersey Adopts Plane-Coordinate System

Recent Act of State Legislature Establishes Uniform Basis for Boundary Descriptions

By PHILIP KISSAM

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ON March 25, 1935, Governor Hoffman signed a bill that had just been passed by both houses of the New Jersey state legislature. This bill defines and adopts the plane coordinate system which has been devised for the state by the U. S. Coast and Geodetic Survey. Its enactment is one of the most important forward steps that has been taken in many years in the very old art of describing boundaries.

"ALL that parcel of land bounded as follows: Beginning at a point...." So runs the description of real property in many a deed both ancient and modern. And so, while surveying instruments and methods have become more and more precise, legal considerations have perpetuated the old method of metes and bounds, which frequently presents well-nigh insurmountable difficulties in locating the point of beginning. Taking a long and important step toward the goal of complete coordination of all surveys and maps in New Jersey, a bill designed to legalize the use of horizontal control survey stations for the boundary descriptions of all private and other property in that state became law on March 25, 1935, when the signature of the governor was affixed. The accompanying article by Professor Kissam gives the advantages to be anticipated from the act and clearly describes the application to New Jersey of the U. S. Coast and Geodetic Survey's "transverse Mercator projection."

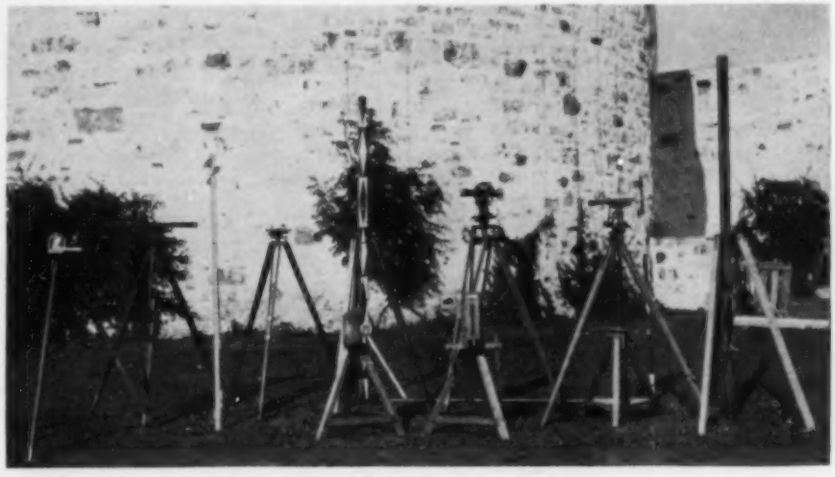
The idea of describing property by metes and bounds instead of relying entirely upon boundary markers like fences and streams, is believed to have developed in ancient times in Egypt, where the fertile lands bordering the Nile were cultivated after the annual flood had subsided and after all marks showing the boundaries of individual properties had been destroyed by the inundation. A crude form of surveying was developed which made it possible to re-run these boundary lines annually. When the compass became an instrument of some precision, the use of metes and bounds became an acceptable aid in the description of property. Owing to the various inaccuracies of the compass, its chief use was to aid in the recovery of old points marking the boundary, and for that reason it never became an acceptable primary method of finding the land.

With the development of the transit and the steel tape, a peculiar condition arose in regard to property descriptions. Over small areas an ordinary transit survey will locate the property as accurately as will markers. Thus descriptions by taped distances and transit angles were more and more relied upon by surveyors required to stake out property corners. However, the old custom persisted of describing the location of a property by reference to a point of beginning difficult or impossible to find, with resulting disagreements in the actual location of the land. Persons transferring property were advised to include in the description references to adjoining properties. Moreover, legal advice often indicated to the person selling the property that he would be more certain in his guaranty of title if he sold the property according to the description of it given in the deed by which he originally acquired it. Thus, partly owing to poor points of beginning and partly to old recopied descriptions which were not accurate enough for the type of real estate involved, there has grown up in this country a peculiar situation —there is no lack of the surveying skill needed to accurately locate property but the results are vitiated by improper methods of application.

PROBLEM OF FINDING THE POINT OF BEGINNING

Another factor that has had an unfortunate effect on the accuracy with which property is located is the importance attached to long and careful search of title. This factor accounts for the fact that descriptions of property have been worded so as to facilitate following the chain of title back to the original grant. This has also encouraged the tendency to use, not a modern description of the property, but the original description as provided to the buyer of that particular division of land.

The land surveyor has thus been confronted with the problem of locating property by an old description and without proper points of beginning. Where the land is in a town, the point of beginning is usually described as being at a given distance and in a given direction from a street intersection. Usually no worse point could be chosen. Street intersections, being on public land and not subject to adverse possession, are



INSTRUMENTS USED IN LOCAL CONTROL SURVEYS UNDER DIRECTION OF THE U. S. COAST AND GEODETIC SURVEY

Including, from Left to Right, Heliotrope, Wye Level, Rod, Declinometer, Typical Sight Rod and Electric Sight, Theodolite and Polaris Observation Mark, Transit and Tape Sight

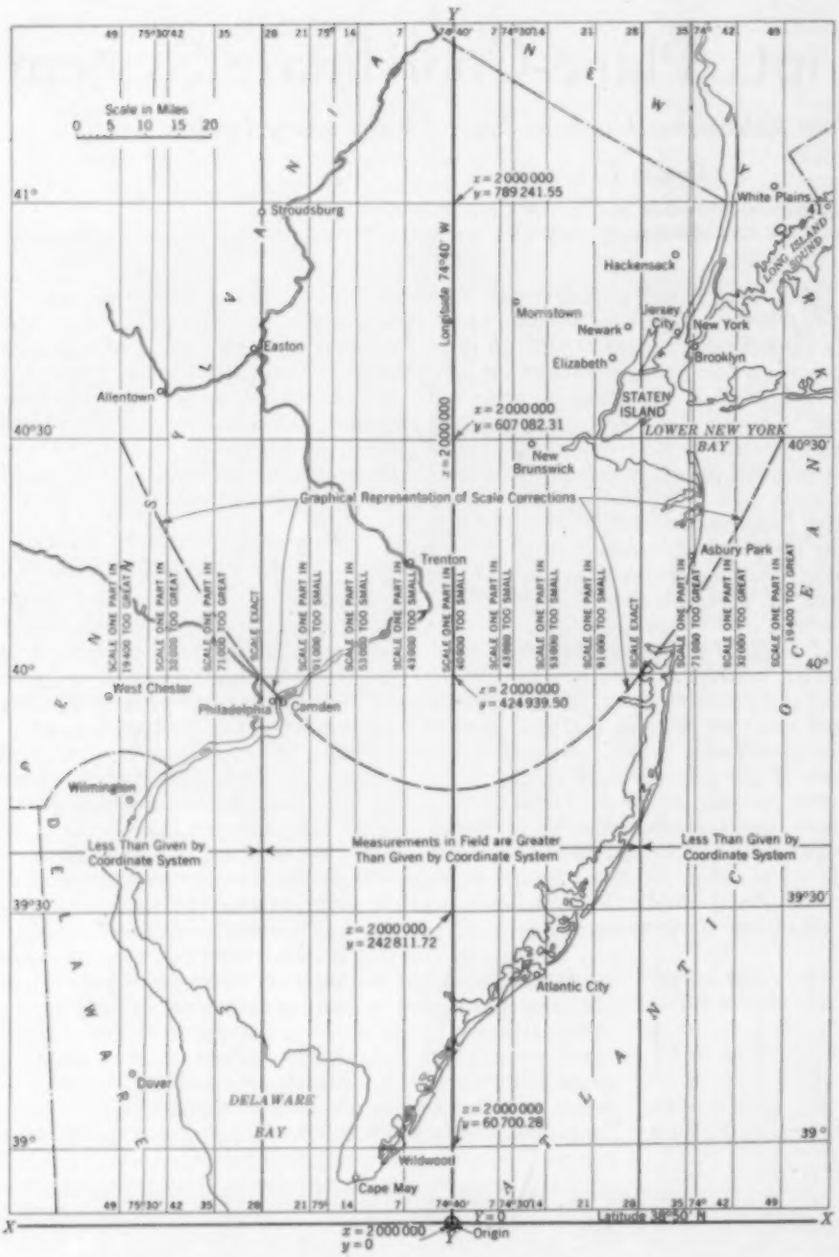


FIG. 1. MAP OF NEW JERSEY, SHOWING THE LEGALLY ADOPTED PLANE-COORDINATE SYSTEM

This System Is Based on the Transverse Mercator Projection of Clarke's Spheroid Developed by the U. S. Coast and Geodetic Survey. The *Y*-Coordinates Are Expressed in Feet North of the Origin at the Foot of the Map. For the *X*-Coordinates, the Central Meridian Is Taken as 2,000,000 Ft East. Note the Scale Factors on the Meridians, Expressed in Miles with Reference to the Central Meridian

not carefully watched, are poorly described, and are seldom officially marked. The determination of a street line becomes almost an impossible feat. Thus land surveyors have been forced to locate property by means of descriptions which do not agree with ground conditions.

A special technic has been developed, and it has become necessary to have special information for each particular locality. Surveyors have often been obliged to do a large amount of research merely to lay out one piece of property. In order to get returns on this research, they found it necessary to resort to private marks to make it impossible for other surveyors to reap the rewards of their expenditures. More confusion developed. Title companies were obliged to employ staffs of surveyors so that it would be possible to locate property consistently over large areas.

With modern surveying skill, this sort of confusion, resulting in expensive boundary litigation as well as costly errors in the location of buildings and other structures, can be eliminated. If the confusion is to be entirely eliminated, however, one important principle must be followed. Throughout large areas points must be established and carefully marked by permanently set and thoroughly described monuments, completely interconnected by surveys, so that the monuments can be replaced, when lost, by surveys from other monuments in the system. The lines and distances coordinating such monuments must be measured by surveying methods of the highest type. Rigid, accurate control for these surveys is essential.

WORK OF THE U. S. COAST AND GEODETIC SURVEY

Starting well over a hundred years ago, the U. S. Coast and Geodetic Survey established a nationwide network of triangulation. To this system Canada and Mexico also tied in their triangulation, thus rigidly connecting all points throughout North America. In 1927 the geographic positions of all stations in the vast network were adjusted and established on a final datum. The positions of the stations resulting from this adjustment are referred to as being on the North American datum of 1927.

The arcs of first-order triangulation of which this network is composed average 10 miles in width and are generally spaced in the form of a grid system at intervals of 50 miles in each direction. Between these primary arcs are arcs of second-order triangulation reducing the distance between triangulation control stations to about 25 miles. Other work of the Coast and Geodetic Survey has further enlarged the areas controlled by triangulation. The State of New Jersey is particularly fortunate in having several thousand triangulation points within her boundaries, and within the next year the entire state will be properly controlled by this net.

Employing men temporarily out of work, and initially through the use of Civil Works Administration funds, the Coast and Geodetic Survey established local control survey projects under its direction in every state of the Union, thus increasing the number of control points available. With the discontinuance of the Civil Works Administration program, these surveys were continued in a number of states under the Emergency Relief Administration. The Coast and Geodetic Survey does not now have control of these projects but acts in an advisory capacity to ensure that the results obtained

are in accordance with the high standards of accuracy necessary for such work.

The greater part of these local control surveys have been made by transit traverses, with results having a ratio of error of less than one part in 10,000. The traverses are run from one triangulation point to the next, azimuth control being determined by special azimuth points set by the Coast and Geodetic Survey at every triangulation station. The field results are adjusted first for proper angular closure and second for traverse closure. In this way very accurate positions are determined for all points in the traverse. Monuments to mark the traverse points are set in pairs, the monuments in each pair being spaced approximately a quarter of a mile apart, so that surveys starting from them will have adequate azimuth control. The pairs of monuments are set at two-mile intervals or less along important highways and important streets in towns.

Thus there is gradually developing throughout many states a complete control net of monumented points conveniently and accurately located. The use of geographic coordinates for these points is too complicated to appeal to the local engineer. Since such coordinates are employed mostly for surveys of large areas, few engineers are familiar with their use. The necessity of developing some simpler system therefore became apparent. As plane rectangular coordinates are well understood and are easy to use, it was felt desirable to develop an adequate system of such coordinates.

APPARATUS FOR COMPARING TAPES, PRINCETON, N.J.
The Left-Hand Post, Which Constitutes One Extremity of the Comparison Base for the Standard Tape, Carries a Scale Graduated to Thousandths of a Foot. Note Thermometer at Left and Tension Mechanism at Right. In the Background Tapes Are Hung Until They Reach Air Temperature

TAKING AZIMUTH CONTROL OBSERVATIONS AT PRINCETON, N.J.
The Instrument Shown Is a 6½-In. Direction Theodolite

The Coast and Geodetic Survey has adopted systems of coordinates for every state in the Union. The Lambert projection was used for states having the longest dimension east and west. Where the area was very large, two or more of these projections were used.

TRANSVERSE MERCATOR PROJECTION FOR NEW JERSEY

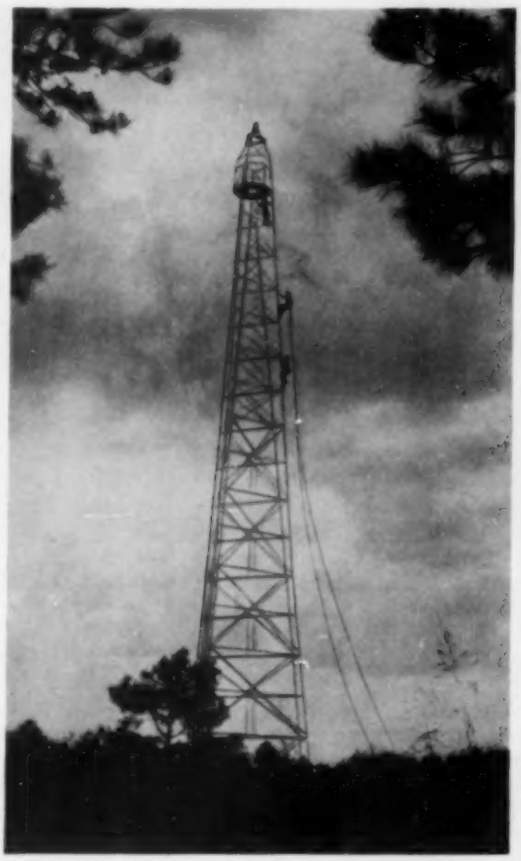
For states having the longest dimension north and south, the Coast and Geodetic Survey developed a novel and ingenious projection having many advantages. This has been called the "transverse Mercator projection." For New Jersey the meridian of 74°40′ west longitude has been used as the great circle which corresponds to the equator in the ordinary Mercator projection, as shown in the accompanying Fig. 1. Distances along this line have been computed from a point just south of the southernmost land in Cape May, actually the point where the parallel of latitude 38°50′ north intersects this meridian.

As the scale of a Mercator projection increases with the distance from the great circle assumed as the origin, it was arbitrarily made one part in 40,000 too small at the central meridian of 74°40′, in order to reduce the scale correction to a negligible factor. Thus, as the scale increases, the error becomes zero at lines drawn parallel to this meridian approximately 28 miles east and west of it. Beyond these lines, the scale of error runs up to approximately one in 40,000 too great at the easternmost point of the state on the Hudson River, and to approximately one part in 20,000 too great at the westernmost point in Salem County on the Delaware River. The meridian of 74°40′ west has been given an east or x coordinate of 2,000,000 ft, and the intersection of this line with latitude 38°50′ north has been given a north or y coordinate of zero feet, thus placing all points in the northeast quadrant, where all coordinates are plus. The x and y coordinates can be distinguished by the number of digits.

Having arranged such a projection for the State of New Jersey, the Coast and Geodetic Survey computed the plane coordinates of nearly all triangulation points within the state boundaries for which the geographic

positions had been determined on the North American datum of 1927. The geographic positions were not determined for the traverse monuments of the local control survey, plane coordinates being used instead.

In the greater part of the state, that is, between the 28-mile lines previously described, an accurate measurement in the field will give a distance slightly greater than that given by the coordinates of the triangulation points, whereas east or west of these lines it will give one slightly less than that given by the coordinates. For all but a few square miles in Salem County, the measured and computed distances agree within one part in 40,000 or better. As the accuracy of surveying work is seldom required to be better than that represented by an error of one in 40,000, this projection is a very happy one. The projection, or grid bearing of a straight line on this projection, is the same throughout the line, but the true bearings of such a line vary approximately one minute per mile for every mile traversed in an easterly or westerly direction.



PORTABLE STEEL TRIANGULATION TOWER AS DEVELOPED BY THE U. S. COAST AND GEODETIC SURVEY

This 116-Ft Tower Consists of Two Independent Structures. The Inner Tripod Carries the Theodolite While the Outer Supports the Observer and Recorder. Steel Ladder Bars Are Provided on Two Verticals for Ease of Construction, Access, and Dismantling

ADVANTAGES TO BE SECURED

The advantages of such a system are immediately apparent. Throughout the entire state, a surveyor making a connection with points on this sytem, and computing the coordinates of his stations by the usual method of latitudes and departures, will arrive at the correct coordinates, based on the New Jersey system. Given a pair of coordinates at each end of a line, the length of the line can be computed by taking the square root of the sum of the squares of the differences of the coordinates. The tangent of the bearing of the line can be computed by dividing the difference between the east coordinates by the difference between the north coordinates.

Thus there now exists in New Jersey a system of monumented points interconnected by surveys with their positions given on a plane-coordinate system extending throughout the state. When a property corner is described by coordinates based on this system, not only is the position of that particular corner capable of precise relocation, but its position can never be lost. It is inconceivable that so many points in the system would be destroyed that no method would remain for accurately locating a particular corner.

France had a system of plane coordinates in the war zone, based on her triangulation net and computed by means of the Lambert projection. The landmarks destroyed during the war were reestablished after the cessation of hostilities by lines precisely located in their original positions as controlled by the remaining triangulation points.

The desirability of this arrangement is apparent to the most casual observer. The mechanics of its use for property descriptions involves certain considerations. The first essential is that it should be unnecessary for the surveyor to describe in detail in each deed the method by which the coordinate system was established. It was to satisfy this condition that the New Jersey legislature passed the act defining the basic system and giving it a name.

Because of considerations involved in search of title and the unfamiliarity of the system in general, it was thought unwise at first to describe property solely by coordinates. Until title examiners become familiar with the system and can compute lengths of sides and grid bearings from the coordinates of the ends of a particular boundary line, and until they become familiar with the coordinates of well-known landmarks, like streets in towns and old lines in the country, so that they can easily find a particular property and adjoining plots from the coordinates alone, it is recommended that the old form of description be continued with the addition only of the coordinates of each corner of the land described, and the following note included in the description: "Coordinates based on the New Jersey system of plane coordinates."

Besides the great advantage of permanency of location of property, several other major advantages of this system are apparent. With ordinary instruments magnetic bearings can be measured only very roughly, and variations in the direction of magnetic meridians are not charted with the degree of accuracy necessary for this type of work. True bearings based on astronomical observations are likewise not a solution. The necessity of giving bearings more accurately than to the nearest minute of arc has long been realized. Unfortunately, because of the convergence of meridians, an east-and-west line 1,000 ft long in New Jersey would have a bearing at one end differing by as much as 12 seconds from that at the other end. The use of two bearings for the same line would require intricate computations and unnecessary detail in the work. Nevertheless, in order to reestablish a line of true bearings and observations on the North Star, just such computations would be required.

Grid bearings computed from the plane-coordinate system, however, are constant throughout the entire length of any line contained within the boundaries of the state. For the first time, bearings will have a definite meaning as well as being merely an adjunct to the description of angles. Deeds for adjoining properties having a common line will now give the same bearing for that particular line.

There are many reasons why the compilation of deed

descriptions is necessary in certain areas. Tax maps, title examination, the acquisition of property by public agencies, all necessitate the preparation of a mosaic of lands made up from recorded descriptions. Because of different and inaccurate points of beginning and a lack of consistency in bearings, these descriptions seldom fit each other. The mosaic requires a degree of guesswork that often seriously vitiates its accuracy. Should old properties in such an area be described by plane coordinates, the compilation of such a mosaic would be a simple matter, and in many cases would be unnecessary.

A simple illustration will be given. When lots in the same block are supposed to abut along their back lines it is difficult to determine, by the use of present deed descriptions, whether the back lines do actually coincide. As a rule, the lots are described as fronting on their particular street, while the distance between the streets is usually a matter of question. Often a survey encircling the entire block is necessary, and even then guesswork enters into the final location of the common back line. When coordinates are used, this difficulty will be obviated.

Again, when rights of way are to be secured for the development of state highways, the vast cost of property surveys prevents proper study of the parcels of land to be acquired. Mistakes of a serious nature sometimes result. The state may actually acquire land that is never used and may fail to acquire some through which the highway passes. If the properties along the route are described by plane coordinates, it will be necessary only for the center line of the highway to be properly tied to points on the coordinate system. The exact size and shape of the parcels to be acquired can then be obtained with facility. Modern planning calls for the acquisition of land by public bodies to a greater extent than ever before. Forest reservations, parks, riparian lands, highways, and public institutions are instances of the need for publicly owned areas. As this method of describing land is more widely adopted, the taxpayers of New Jersey will be saved large sums of money each year.

NEW JERSEY ACT TO ESTABLISH A SYSTEM OF LAND BOUNDARY DESCRIPTIONS

BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey:*

1. The official survey base for New Jersey shall be a system of plane coordinates to be known as the New Jersey System of Plane Coordinates, said system being defined as a transverse Mercator projection of Clarke's spheroid of 1866, having a central meridian 74°40′ west from Greenwich, on which meridian the scale is set at one part in 40,000 too small. All coordinates of the system are expressed in feet, the x coordinate being measured easterly along the grid and the y coordinate being measured northerly along the grid, the origin of the coordinates being on the meridian 74°40′ west from Greenwich at the intersection of the parallel 38°50′ north latitude, such origin being given the coordinates x = 2,000,000 ft; y = 0 ft. The precise position of said system shall be as marked on the ground by triangulation or traverse stations established in conformity with the standards adopted by the United States Coast and Geodetic Survey for first- and second-order work, whose geodetic positions have been rigidly adjusted on the North American datum of 1927, and whose plane coordinates have been computed on the system defined.

2. Any triangulation and/or traverse station established as described in section one of this act may be used in establishing a connection between a property survey and the above mentioned system of rectangular coordinates.

3. No survey of lands hereinafter made shall have endorsed thereon any legend or other statement indicating that it is based upon the New Jersey System of Plane Coordinates unless the coordinates have been established on that system as herein defined.

4. Nothing in this act contained shall be interpreted as requiring any purchaser or mortgagee to rely on a description based wholly upon the aforesaid system.

5. This act is to take effect immediately.

FULL USE OF SYSTEM TO BE ATTAINED GRADUALLY

It is generally conceded that the full use and development of the plane-coordinate system must be attained by degrees. The advantages gained by the owner of property thus described should be pointed out by every thoughtful land surveyor. If a property is within a quarter of a mile of control points, it is believed that the necessary survey connections can be made without undue cost to the land owner. Areas of property described by coordinates will thus develop around the control points. Undoubtedly, in making these surveys, the surveyors will establish points that can be used as a basis for extension of the system.

When the public becomes aware of this system, there will be a demand for the use of coordinates in describing properties acquired. This will force private and public surveys to be run, extending the system even further. Many towns in New Jersey are already considering municipal ordinances requiring that the plane coordinates of property corners in new subdivisions be stated on the approved plans. Modern ordinances are being developed with the general idea that all subdivisions within a quarter of a mile of control points will be required to show coordinates of corners on the filed plan. Those subdivisions lying more than a quarter of a mile from these points will be prohibited from using standard coordinates, according to present plans.

The law described provides a method for establishing official control points by any surveyor if he uses the method adopted by the U. S. Coast and Geodetic Survey for second-order traverse or triangulation work. Thus, subdivisions which wish such coordinates and which lie within a quarter of a mile of the present monuments can make use of them by establishing a traverse according to these requirements. In this way the use of the plane-coordinate system will be extended.

It is unnecessary to point out that the control points form a basis for all types of engineering surveys, not only providing a convenient and accurate method of checking and controlling these surveys, but also providing a horizontal datum which will automatically interconnect all surveys and maps based on this system. The engineering advantages of such a control system are sufficient to require its establishment. New Jersey has had the foresight to facilitate its use in property descriptions.

DISK USED FOR STATIONS, U. S. COAST AND GEODETIC SURVEY

A Timber Lift-Span Bridge

All-Wood Construction Proves Eminently Satisfactory for Temporary Railroad Purposes

By H. J. WHITLOCK

ASSOCIATE MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

ASSOCIATE DESIGNING ENGINEER, DIVISION OF HIGHWAYS, DEPARTMENT OF PUBLIC WORKS, STATE OF CALIFORNIA, SACRAMENTO, CALIF.

IN removing the old "M" Street bridge across the Sacramento River at Sacramento to make way for the so-called Tower Bridge now under construction, it was necessary for the California State Highway Division to provide for both railroad and river traffic by means of a temporary bridge with movable span, to be constructed low enough so that the old draw span, while still in use, could swing over it. The latter condition required that the base of rail on the temporary span should be not more than 20 in. above high water. Under these circumstances, having given due weight to the factors of speed and economy, the Division fixed upon a timber vertical-lift span as the best type of temporary bridge for the purpose. The accompanying article by Mr. Whitlock presents very clearly the difficulties involved and the way in which they were met in the design and construction of this unusual wooden bridge.

PRIMARILY, the Tower Bridge project at the site of the former "M" Street Bridge across the Sacramento River at Sacramento, Calif., is designed to furnish a new and modern highway entrance into Sacramento. In its entirety it will cost in excess of a million dollars. It is on the direct route between Sacramento and San Francisco, and facilities will be provided for traffic on transcontinental U. S. highway route No. 40, on U. S. highway route No. 99 W, north and south, and also for a considerable volume of local vehicular and pedestrian traffic. In addition, the tracks of the Sacramento Northern Railway, an interurban electric line, will be carried on the bridge.

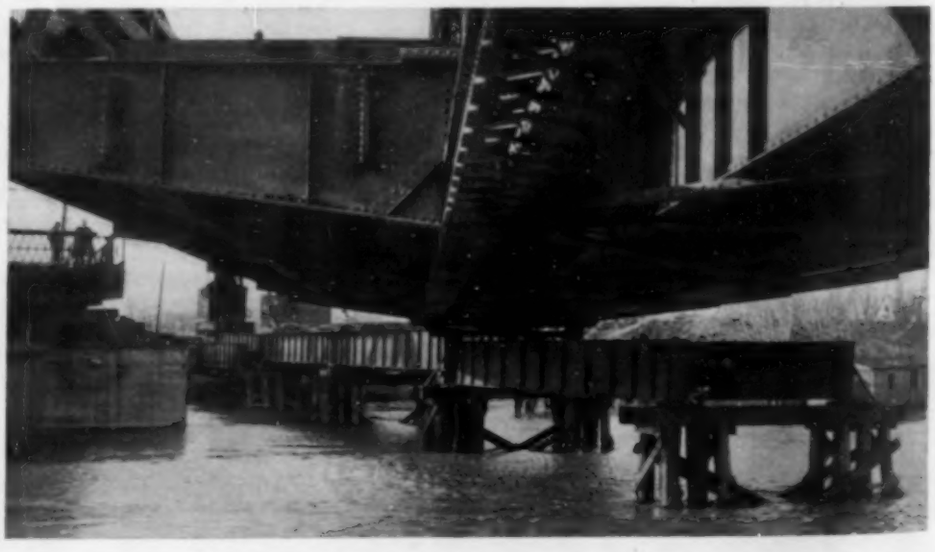
In order of construction, the work includes the following: Improvement of the roadway and approaches of the adjacent "I" Street bridge to increase its capacity as a detour route for vehicular traffic while the new bridge is under construction; construction of a temporary bridge and approaches to carry the Sacramento Northern Railway tracks during the construction period; construction of the new bridge, which is to include a movable span of the vertical-lift type; and reconstruction of both highway and railroad approaches to afford greater traffic capacity with less interference between the two types of traffic.

The work on the "I" Street bridge was completed in the spring of 1934. Construction of the temporary railroad bridge was completed in February 1935. It is with the last-mentioned structure that this article is primarily concerned.

The old "M" Street bridge, of the swing-draw type, had been built during 1912 and 1913 as a joint project by a number of interurban electric lines, since merged into the Sacramento Northern Railway system, to provide a crossing of the Sacramento River for traffic from the west side of the valley. Under agreement with the boards of supervisors of Sacramento and Yolo counties, provision was made for vehicular and pedestrian traffic. With the development of the state highway system, two of the principal highways touching Sacramento were routed over this bridge, with the result that it had been a veritable bottleneck for some time. After the usual delays and difficulties involved in securing an agreement of all interested parties, it was decided in 1933 that the state should build a new bridge at the site of the old one to relieve the congestion. Because the railroad was surrendering its bridge, the state agreed to provide facilities in kind for the unexpired period of the railroad franchise.

TEMPORARY BRIDGE TO CARRY RAILROAD TRAFFIC

It was immediately recognized that providing for traffic during the construction period would constitute a major problem. As previously mentioned, it was possible to route automobile and truck traffic over another bridge, but there was no feasible way of handling the railroad traffic except by means of a temporary structure. Since approximately 36 scheduled trains, both freight and passenger,



CONSTRUCTING FIXED GIRDER SPANS OF TEMPORARY BRIDGE

The Girders in the Foreground Have Been Erected Directly on the Pile Bent Caps to Clear the End Lock of the Old Draw Span Above. When the Old Bridge Went Out of Service, These Girders Were Jacked Up to the Same Elevation as the Spans in the Background and Bearings Set

pass over this line daily, and since the river carries considerable boat traffic, the need for a structure with some form of movable span operating promptly and reliably was indicated.

The problem resolved itself into a number of factors, some of them conflicting. Wharf and building developments on the Sacramento side made it impossible to secure a crossing at a sufficient distance from the old bridge to clear the arc of its movable span, except at prohibitive cost. Low steel on the old bridge was but $4^1/_4$ ft above recorded high water, which provided very little clearance for any structure set low enough to permit swinging the old draw span over it to accommodate boat movements.

Consideration was given to timber trestle construction for the fixed part of the structure. But the river when in flood has a mean velocity of over 5 ft per sec at this point and carries considerable drift, so that any practical design would offer considerable obstruction to stream flow. Fortunately it proved possible to locate a number of E-50 through plate-girder spans of 50-ft length, which one of the railroads had replaced with heavier steel. Nine of these were rented and used for the fixed part of the main river crossing.

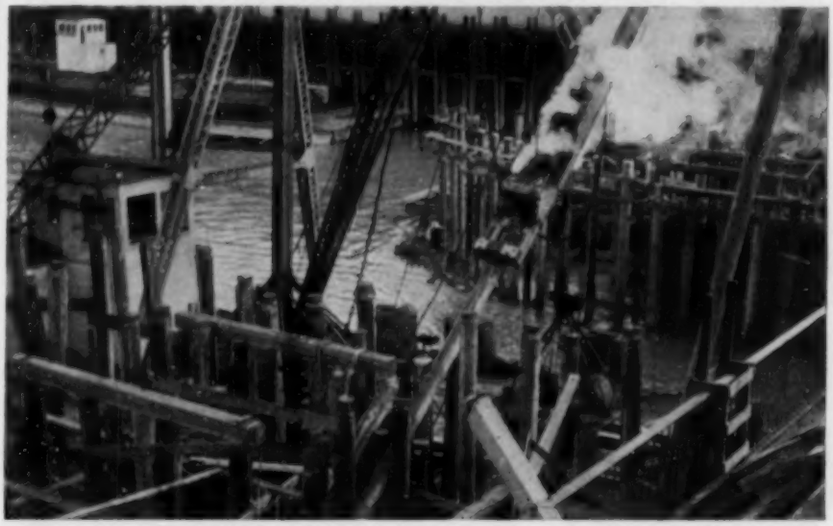
These girders were set at an elevation such that their top flanges barely cleared low steel on the swing span of the old bridge. This put their low steel 16 in. below high water. Since the Sacramento basin had experienced comparatively light runoff for a number of years, it was hoped that this would continue through the construction period. Nevertheless dependence was not placed altogether on hopes, and particular attention was given to bracing the entire substructure, which is of untreated Douglas fir piling.

By record the high-water mark is at El. 32.7, all elevations being given to U. S. Engineering Department datum. By summer sounding, the bottom of the channel that must be kept open for navigation is at approximately El. −15. The remainder of the river bed varies, but averages approximately El. −10. There is a layer of large gravel and boulders at El. −50, overlaid first with clay and then with sand and silt. It was expected that the channel would be scoured out to a depth of at least 10 or 15 ft during flood flow.

To reach a formation that would provide good bearing values presented no unusual problem. But it was found to be another matter to brace the piling economically so that there would be no difficulty due to bending and lateral deflection, particularly under lateral loads, with a bottom scoured to at least El. −25 or −30 during flood, and subjected to flood flow with crest at approximately El. +30.

The first few spans next to the abutments are of such typically timber trestle type as not to require special comment. Data on timber connectors had become generally available just prior to this design work, and these were used to a considerable extent throughout the timber construction (*Modern Connectors for Timber Construction*, U. S. Department of Commerce, 1933).

The plate girders are supported on pile bents or piers composed of 12 piles, grouped in two clusters of 6 each, under transverse caps which in turn support the plate girders. The two rows of pile clusters are battered in opposition to each other in a direction parallel to the longitudinal center line of the structure, to develop resistance to braking loads. The bracing parallel to the direction of stream flow is two panels in depth and extends down to El. 0.00. The upper part of this bracing is shown in one of the photographs. The lower horizontal bracing was erected under water by a diver. All bracing above the summer water level was fastened by toothed ring connectors at each bolt, and bolts were used in greater numbers in the plane normal to the longitudinal center line than is usual in ordinary timber trestle construction. This was done to fix the upper part of the piles as a group to as low an elevation as possible, thus developing the maximum resistance of the piling against current, drift, and lateral live load, all of which might be acting in the same direction. Below the water level, the toothed ring connectors were omitted from the fastenings and the size of the bolts was increased.



DRIVING BATTER PILES TO BRACE TOWER SUBSTRUCTURE
Piles 100 Ft in Length Were Driven at an Angle of 45 Deg to Strengthen the Substructures of the Temporary Towers

Since the railroad operates with electric power only, and the maximum load to be carried consists of maximum size freight cars, the stresses due to axle concentrations approximate those of an E-40 loading. It was accordingly unnecessary to rivet the floor system, and bolts were used instead, as a matter of economy both in erection and in dismantling after completion of the new bridge.

DECIDING UPON THE TYPE OF MOVABLE SPAN BEST FITTED TO THE NEEDS

In deciding upon the type of movable span to be used, consideration was given to two principal factors besides economy. The small distance of 20 in. between the base of the rail and recorded high water made it imperative to avoid all construction possible below this base. The depth of the construction below high water, much of which it would be difficult to brace, made it desirable to avoid lateral forces as much as possible. A consideration of the various factors led to the adoption of a vertical lift span, although it was recognized that the particular requirements of the site would present some special problems not met by the conventional type.

Unusual bracing of the pile tops at a height of some 60 ft above river bottom was necessary to secure the tower

Members Were Grooved to Receive the Split Rings in the Gussets

Upper Part of Towers Was Set with Derrick Boom Extension

Plates of 29-Ply Panelwood Were Used in the Towers

CONSTRUCTING TEMPORARY TOWERS FOR TIMBER LIFT SPAN

legs under train and wind loads. Bracing piles were driven at a batter of approximately one to one and framed into the bearing pile clusters with bracing attached to transmit lateral loads. There was some discussion as to whether this was feasible, but investigation showed it to be. The piles were specially selected and ranged in length from 97 to 100 ft, this length being necessary to develop bearing. The vertical piles were driven first and the batter piles placed between and supported by blocking attached to the vertical piles. The single-acting steam hammer used for driving was mounted in a swinging lead. Although of necessity the driving went somewhat more slowly than in straight work, the piles went home and to date there has been no difficulty experienced from change in distance between towers.

The towers themselves presented an interesting problem in temporary construction. The distance from the front-leg bearing plates to the center line of the counterweight sheaves is 112 ft 4 in. In addition to carrying the vertical load of truss and counterweights, the towers are designed to retain a satisfactory stiffness under wind load with the span in the fully raised position. Consideration was given to rapidity of construction, elimination of the need for falsework, and possible salvage value. To meet these requirements the towers were designed for fabrication with split-ring connectors, and subdivision was practically eliminated.

Guides for the lift span consist of steel straps blocked out on wooden filler strips and fastened to the two faces of the front interior corners of the main legs. The filler strips were provided to make possible an adjustment of clearance should unexpected warping, deflection, or other circumstance make it necessary.

To provide railroad clearance through the transverse planes of wind bracing at the bottom of the towers, lateral stresses were passed through main joints immediately above the railroad clearance line. Since the number of members entering these joints required gusset plates of considerable size, it was not believed that timber slabs would be suitable, even if available, because lateral shrinkage in the gussets would be opposed by the end grain of the members and vice versa. Steel gusset plates were considered but presented difficulties in developing the split rings due to the lack of a core.

WOOD USED FOR GUSSET PLATES

The joints were finally designed with gusset plates of 29-ply veneer panelwood built up with waterproof glue. One of these joints is shown in a photograph. On each side of the joint there is a gusset plate 4 ft 9 in. wide, 3 ft deep, and 4 in. thick. To the best of my knowledge this is the first instance of the use of such plywood construction. Plywood gussets were also used in anchoring the tower legs and bracing to the tower substructure.

Each face of the towers was fabricated on the ground, all the holes being bored and all the ring grooves cut. The parts were match marked, rings placed in the grooves of one member of a joint, and the members yarded until erection time. A floating derrick was used for erection. The members were brought alongside on a barge, and hoisted into place, and the bolts were inserted in the holes in a manner very similar to steel erection. In tower No. 2 on the Sacramento side, which was erected first, the members were placed piece by piece. Profiting from experience gained during the construction of this tower, the second one was erected in sections. Some of the sections erected in one piece, comprising the three legs on one side, were as much as 50 ft long.

A carpenter clinging to a nearly vertical 10 by 10-in. timber with linemen's spurs and belt, at a height of 70 or 80 ft above the water, and equipped with bolts and wrench, awaiting the lowering into place of the next section or member, presented a rather unusual picture. Such methods were, however, very effective in speeding erection.

The counterweights are timber frames lined with tongue-and-groove flooring and filled with a mixture of graded sand and gravel to give the necessary weight. This material was used because it was available at a weight of 120 lb or more per cubic foot and offered a convenient means of adjusting the amount of counterweight and of dismantling when the bridge was no longer needed.

DESIGNING THE LIFT SPAN

Certain requirements and local conditions resulted in the development of a design for the lift span, differing, in some respects at least, from typical vertical-lift bridge construction. The War Departmet required a clear width between fenders of 80 ft and a vertical clearance of 85 ft above high water. The state Railroad Commission required rail locks or rail joints at each end of the lift span and derail switches on the approaches. These locks or joints and derail switches were required to be interlocked so that the bridge could not be raised unless the derail switches were open, and so that the derails could not be set for train passage until the span was in place and the rail joints locked.

Since the length of 90 ft from center to center of end floor beams indicated a pony truss as most desirable from a purely structural standpoint, a Howe type truss of timber construction with steel hangers was adopted.

The necessity for locating the base of rail only 20 in. above high water required placing the floor beams below the lower chords to raise the chords so as to present the minimum of obstruction should it be necessary to lower the span during the passage of a flood crest. Split ring connectors were used in chord splices and as dowels between the floor beams and the lower chords. Otherwise the truss presented no unusual features of timber construction.

As the pony truss afforded small opportunity for mounting operating machinery on the lift-span in the conventional manner, this machinery was divided into two units, one in each tower. It was decided not to fully counterweight the span, but to leave it approximately 30,000 lb heavier than the counterweights, and to open it for navigation by hoisting the unbalanced load and then lowering it by gravity under control to reestablish rail service.

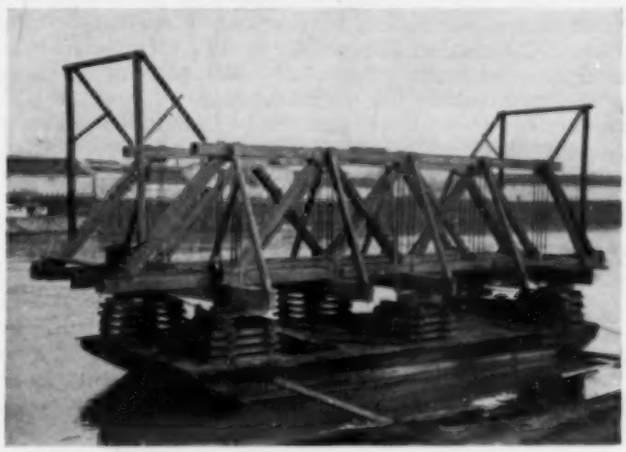
This method was believed to have several advantages. It was possible to avoid any sheaves for down-haul ropes, which would have had to be below the bridge seat to be effective and consequently below the high-water line. As long as the reaction is positive, the span obviously cannot rise out of position unless the motors are energized, and protection in this regard is given by interlocking the control circuit with the derail switch position. It was thus possible to avoid the purchase of expensive rail-lock and bridge-lock mechanism which otherwise would have been required and would have been very difficult to mount in the limited space available above high water.

The machinery in each tower consists of a single drum hoist. The drum has two sections, each scored so that two lines are handled simultaneously. In reality the two lines are a single piece of wire rope rove through two sets of blocks with the double-fall block attached to the end-post shoe of the truss at the lower chord. Instead of dead ending in beckets, what would ordinarily be the ends are carried over idler sheaves at the top of the tower on each side and through a clamp located between them. This provision made it possible to equalize the two sets of blocks at each end very quickly after landing the span and attaching the cables. The clamp was left free, and a slight pull was taken on the hoist until the slack was distributed between the two sets of blocks. Tightening the clamp then insured that the two sides of one end would be hoisted uniformly.

MOTOR AND CONTROL EQUIPMENT

Each hoist is powered with an alternating-current, wound-rotor motor and equipped with service and emergency brakes, each brake being spring loaded and released by an electro-hydraulic mechanism.

All apparatus is controlled from an operating station alongside the track in the base of the Sacramento tower. The motors are handled in parallel from a single controller. The control in the hoisting operation is typical of wound rotor variable-speed motor control, but in lowering, a less common method of control, known as plugging, is employed. On the first four controller points, the magnetically-operated motor primary hoist switch is closed, but resistance is introduced into the secondary circuits in such amounts that the motor cannot develop sufficient torque to raise or, for that matter, even hold the unbalanced weight of the truss. The excess weight of the span, as compared to the counterweight, causes the motor to turn backward, the speed being controlled by the amount of resistance used. Speed on the fourth controller point approximates the synchronous speed of the motors, and the fifth point reverses the motor primary to give a motor speed, under overhauling load, slightly in excess of the synchronous speed.

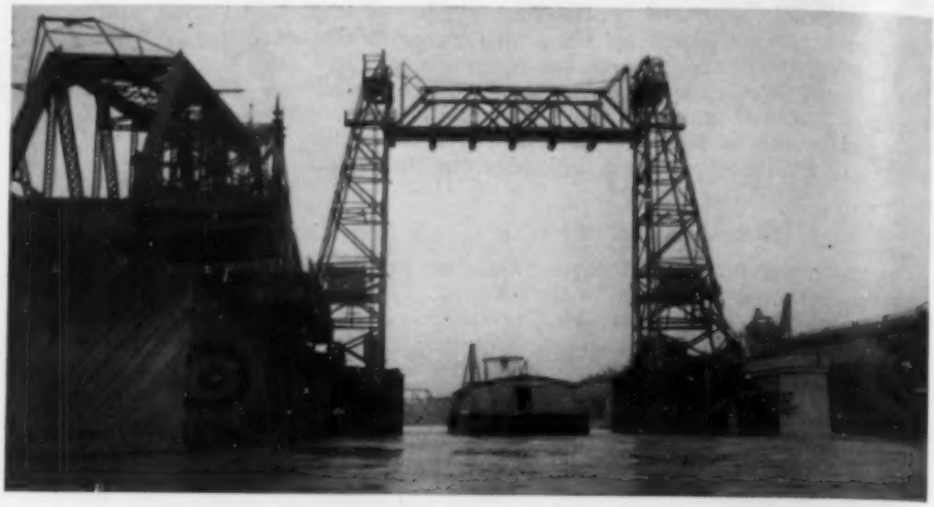


COMPLETED LIFT SPAN READY TO BE FLOATED INTO PLACE
The Frames Projecting at Each End Carry the Train Trolley Wires

A difference in the speed of the two motors is natural due to the difference in length of their circuits, and also possibly to other causes. Hence a second controller is provided to maintain the two ends of the truss at approximately the same elevation. This controller operates by cutting resistance in or out of the secondary circuit of the leading motor, as may be required to slow it up. Apparatus has unquestionably been assembled before for providing differential speed control between two motors on a common controller, but as far as is known this is the first instance of its use on motors operating either as straight hoist motors or plugged. This

presented certain complications in control-circuit design, due to the inherent speed characteristics of induction motors with regard to change in secondary resistance being reversed as between hoisting and plugging operation. In order to prevent the operators from becoming confused, a method was finally devised whereby a given controller movement always slows up the same motor.

The operator is guided in his use of the controllers by an electrically-operated position indicator and skew-limit control designed especially for this installation. This indicator is electrically operated by means of two generators, or transmitters, each being driven by one of the drum hoists and electrically connected to a motor or receiver which is geared to a pointer on the face of an 18-in. dial. The transmitters and receivers are stock units furnished by an electrical manufacturer. The transmitter and receiver of each hoist unit are self-synchronizing with respect to each other, and thus any movement of the hoist drum causes movement of the pointer for that end of the span. The pointers and their spindles are insulated from each other and from their mounting and are fitted with sliding contacts between the pointers thus providing a skew-limit device in the master control circuit. The two pointers, mounted coaxially, one behind the other, indicate the height of their respective ends of the bridge. As long as they keep together the control circuit is maintained through them. If, however, one end becomes higher than the other, the pointers separate, breaking the circuit to shut off power to the motors and to set the brakes. The bridge then must be leveled by special individual motor control to restore the skew-limit contact in the pointers before travel can be resumed. The pointer contacts can be adjusted as to the amount of skew allowed before the control circuit is broken.



COMPLETED TEMPORARY LIFT SPAN OPEN FOR NAVIGATION
A Pier of the Permanent Lift Span Appears at the Right

SWINGING THE LIFT SPAN

In the fabrication of the movable span, the trusses were framed on the platform used for framing the towers and then erected on a barge. One of the photographs shows the truss erected on a barge, ready to be floated into place. The size of the members may be estimated by comparison with the figures of the men. The floor beams are 24 in. in width by 26 in. in depth.

The counterweight boxes were hoisted into a position slightly below that which they would have when fully raised, supports being provided for them on the tower legs. They were then filled with sufficient aggregate to partially counterbalance the span. The span was floated into position; the load was transferred from the barge to the bridge seats by means of jacks; and the counterweight and lifting cables were attached to the trusses. The jacks were lowered to swing the counterweights, and the span was hoisted to free the jacks.

On January 30, 1935, the span was lifted for the first time, and on February 4 trains were regularly routed over it. Operation through the spring and summer has been entirely satisfactory. The construction of a timber lift span is somewhat unusual. While this particular installation will be in operation only until the new bridge is completed, which is expected to be in November 1935, it is believed that it would give satisfactory service for the normal life of a timber structure. Undoubtedly the use of the timber connectors, both toothed rings and split rings, resulted in a considerable increase in unit costs for the amount of timber used. It is believed, however, that results were secured in strength and stiffness that could not have been obtained otherwise without the use of a considerably larger amount of material. Also it is believed that results were secured in the erection of the towers that could not have been achieved by other means.

In view of the extremely low elevation at which it was necessary to construct the temporary bridge, it is interesting to note the effect of high water during the past spring. Although the season, past records, and the snow pack in the mountains at the time of swinging the lift span indicated that any probability of extreme high water was over for the spring of 1935, heavy and somewhat unseasonable storms in April changed this outlook. A storm on April 6 and 7 caused precipitation of unusual intensity and duration over a large part of the watershed tributary to the Sacramento River. The river rose rapidly on April 8 until the mean surface of the water barely cleared the lower flanges of the girders, and it was necessary to duck the drift under them. Wave crests were cut off by the lower flanges and deposited light drift on them. The floor beams of the lift span, with span seated, were half submerged in the water, and the span was kept raised to minimize obstruction to drift, except when necessary to lower it for the passage of trains. There was no interruption to service. A heavy flow of drift accumulated against the girders and piers at one time and caused some concern, but it was broken loose, principally by means of a scow clamshell. The entire structure is apparently none the worse for the high water.

The bridge was built by the George Pollock Construction Company, general contractors for the entire project, with the exception of the alterations to the "I" Street bridge. All the engineering work, including the preparation of plans and specifications and the construction engineering, was done by the staff of the Bridge Department, Division of Highways, Department of Public Works of the State of California.

Surety Bonds and How to Negotiate Them

Procedures and Limitations Required Before the Contractor Can Satisfy the Underwriter

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ENGINEERS who are acquainted with bonds by name rather than by intimate experience will find much information in this paper. It explains what parties are involved in the obtaining of bonds, the relationships between these parties, and their activities during the process. Engineers will find that this discussion will facilitate their more complete understanding of the complex problems involved, particularly as to the methods used by the surety to check on the contractor applying for a bond. In all these negotiations, the underwriter must effectively combine the functions of financier, contractor, lawyer, and detective. Drawing on a rich experience, Mr. Knight has generously illustrated these points and has shown the dangers inherent in many current tendencies and the successes that have followed rational and businesslike procedures. Readers may wish to refer to a previous paper by Mr. Knight entitled "What Is Suretyship?" which appeared in the October 1935 issue.

WITH an understanding of the fundamentals underlying surety bonds, as outlined in a previous article in these pages, engineers may wish to learn some of the details of the structure and use of such bonds. This paper will outline the mutual relations between the contractor and the bonding company leading up to the execution of a bond by the surety.

There are always three parties to a bond: (1) The party in whose favor the bond is written—known as the "obligee" or, in case of more than one, the "obligees"; (2) the party in whose behalf the bond is written, known as the "principal"; and (3) the party who acts as guarantor, known as the "surety." When any individuals or corporations enter into an agreement, that is, a contract, they are bound only to each other, and to no others, for faithful compliance with such agreement; but the moment that a bond or instrument of indemnity is executed for the purpose of protecting one of the parties to such an agreement, the contract ceases to be a two-party agreement, and becomes instead a three-party obligation. The party protected by such indemnity is then bound to the surety to perform his obligations under the contract as implicitly and as completely as is the principal, the party in whose behalf the bond is written.

OWNER HAS OBLIGATIONS TOO

This is a point that engineers, and others involved in the administration of contracts, often fail to realize—that the acceptance of the guarantee binds all parties, and that the owner is no longer at liberty to the same extent and degree as if he had not required and accepted the guarantee. It is because of the failure to recognize this fact that much of the litigation in connection with contract bonding has arisen, and that inequitable clauses have crept into bonds for the benefit of the obligee against what would otherwise be, except for such clauses, the rights of the guarantor—for example, such clauses as those which give the obligee the right of unlimited change, action, or forbearance, in respect to plans, specifications, or conduct of the work, without notice to or consent of the surety, and warrant in effect any action on the part of the obligee, without in any way invalidating the bond.

A single instance will illustrate this point. A memorial library, of fine material and finish, was under contract. As the work progressed, the contractor was constantly requesting payments in advance. The trustees, fearful of the effect of discontinuance of the work, complied with the contractor's demand until they had practically exhausted the retained percentage. The contractor then defaulted. The trustees called upon the surety to complete, which it of course refused to do under the circumstances. Yet this is only one of many instances illustrating the fact that those whose business it is to comply with every requirement of the contract for the protection of the surety as well as of themselves, fail to do so, and when the surety refuses to complete, or contests legal proceedings for enforcement, they malign all suretyship and denominate all bonds as only "scraps of paper."

I emphasize this point, because it is one too often overlooked in connection with the carrying out of bonded contracts. It will be evident, then, that a contract bond is in essence a conditional note, endorsed by the surety, which the performer (the contractor) gives to the owner. It is not a guarantee of performance but is a guarantee against the consequences of non-performance, and against such consequences only to the extent and degree that there has been complete compliance with each and every term of the contract, the plans, the specifications, and the bond.

PROCEDURE FOR SECURING A BOND

It will be assumed that the problem of securing a bond on an anticipated bidding confronts the contractor and the surety company which he selects for the execution of the final bond. Whether the bidding is done on the basis of a bid bond or by certified check, it is always wise, and often necessary, to arrange for the final bond in advance of bidding. One instance will serve as an illustration. A well-known firm of contractors was the low bidder on a large government contract. Such work had been their specialty for years. They had much of the equipment required, but their financial resources were somewhat limited considering the gross amount of work involved. They did not arrange for their bond in advance of bidding. Surety companies refused to write the bond, even though the bid was adequate, without a substantial increase in funds. They were unable to secure sufficient funds with which to meet the demands of the sureties, and as a consequence lost the work and the satisfactory profit which reasonably could have been expected from it, all because they had failed to obtain the commitment of suretyship in advance of bidding.

"Anyone can get a bond," is an almost universal comment. But any contractor who tries to do so on

limited capital or experience will find out quite differently.

To the "applicant," the term by which the bidder is known in suretyship, the surety presents two documents to be filled out in their entirety. These are the "application" and the "financial statement." In the application (Fig. 1) the bidder must detail his entire personal and business history with great particularity. He must also give all the important facts connected with any work which he has previously performed, any other work which he may have on hand at the time, information as to what protection he carries or intends to carry covering liability or workmen's compensation, and what obligations, other than contractural, he may be under or may anticipate. He also agrees to pay the premium charges for the service rendered by the surety. Lastly, and of great importance, he makes a complete assignment of all his assets, both present and prospective, including the proceeds from the contract in question, for the benefit of the surety. He also gives it title to all his equipment and facilities for the execution of this contract, in the event of default, and in every way indemnifies it against any losses whatsoever which it may incur in connection with, or because of, the execution of this bond.

The financial statement referred to is a very complete presentation of the assets and liabilities of the applicant, in such detail that the surety can determine with great accuracy his net liquid resources as well as his net worth, the value of his securities and investments, whether in real property or otherwise. The surety in this depression period will not be greatly interested in real estate, frozen assets, or slightly obsolete equipment, its interest being chiefly in cash or quickly convertible assets.

INVESTIGATION OF APPLICANTS

Having filed these documents, the applicant must wait until the surety executives have had time to study his case before learning whether or not he is a good bonding risk. The *modus operandi* for correctly appraising an applicant's real measure and acceptability is well defined. The points covered are seven, which may be characterized as the "seven *P*'s" of contract suretyship.

1. *Proposal.* Is the price adequate for the performance of the work and does it give promise of a fair profit? If the surety is doubtful about this controlling factor, the chances of its granting a bond are very remote. If such doubt arises, it is the business of the applicant to convince the surety, by his estimates, subcontract offerings, and general analysis, that his price is satisfactory, even though it may be materially below the prices of the other bidders. Such an opportunity to justify the bidding price is readily granted to applicants, and often makes possible the writing of bonds that initially seemed impossible. I recall clearly negotiations incident to a certain bond for the construction of a subway section, where the low bidder was over $2,000,000 under his next competitor and several millions below the general average of the bids. That the price was fully adequate is evidenced by the successful completion of the work without loss by, or recourse to the sureties; but, because of the great disparity in the bids, several months elapsed before the sureties were convinced of the wisdom of guaranteeing this bid. New methods, new economies, new initiative have been fostered and furthered by this open-minded, yet careful, attitude of the surety companies, and the net result has been a great gain to the construction field as a whole—a conservation of funds and an extension of financing to many enterprises which otherwise might never have been able to go forward. I could instance many other cases indicating that while price is a large and controlling factor, a low price has not been an insuperable obstacle when backed by knowledge and ability.

2. *Possessions.* What is the applicant worth?

APPLICATION FOR CONTRACTOR'S BOND

CONTRACT DEPARTMENT

To be used without change by individuals, co-partnerships and corporations for Contract or Proposal Bonds.

Agent ..... Location .....

Applicants must give full and explicit data under the following heads, and must supply copy of contract and specifications for filing with this application. The information asked for is essential to the proper preparation of the bond and the Company's judgment of the case, hence care in answering will expedite the issuance of the bond.

Application is hereby made to the ..... CASUALTY COMPANY, by the undersigned, for a bond or undertaking, the nature of which is set forth below:

1. Full name of Applicant .....
2. Business address ..... (Street, City and State)
3. **If a co-partnership, give names of individuals composing same:**

Co-Partnership	NAME	ADDRESS	AGE

Separate statement must be filled up and signed by each member, showing his individual assets and liabilities, exclusive of his interest in the firm's business.

Has any member of the firm ever failed in business? .....

4. **If a corporation, answer these questions:**

In what State incorporated? ..... When incorporated? ..... Principal office .....

Authorized Capital $ ..... Capital subscribed for $ ..... Capital paid in cash $ .....

President's name ..... Vice-President's name .....

Secretary's name ..... Treasurer's name .....

Directors' names .....

What officers under your charter are authorized to sign a sealed instrument of writing, binding on the corporation?

5. To whom is bond to be given? ..... (Give full name and business address. If a corporation, give exact corporate title)
6. Nature of contract ..... (Give complete description and location)
7. Amount of bond required, $ ..... (If proposal bond, so state and mention date of opening)
8. Contract Price, $ ..... (If contract price is per unit of measure, so state and give probable total of contract)
9. Premium Agreement:

First. If a proposal bond, the estimated total of contract is $ ....., and the undersigned jointly and severally agree to pay $ ..... premium for said proposal bond upon the execution of the bond or undertaking. When will awards be made? .....

Second. The initial contract premium or charge which the undersigned jointly and severally hereby agree to pay to the Casualty Company for the bond herein applied for shall be ..... being computed at the rate of $ ..... per $1,000 of the contract price stated above for the { term of two years or fraction thereof, / first year or fraction thereof, } and annually in advance thereafter a subsequent premium at the rate of $ ..... per $1000 on the amount of the unfinished contract until the undersigned shall have served upon the Casualty Company at its principal office in the City of ..... competent legal written evidence showing the Casualty Company to have been fully discharged and released from any and all liability on said bond and from all matters arising therefrom. Should the contract price exceed the amount stated in paragraph 8 hereof, the undersigned agrees to pay the Casualty Company on demand as excess or additional premium a further sum, calculated for such excess contract amount at the rate per $1,000 thereof applicable to the initial contract premium or charges, and should the contract price be less than the amounts stated in paragraph 8 hereof, the Company will refund to the undersigned, as return premium, a sum calculated at the same rate per $1000 on the difference between the stated contract price and the actual contract price.

Third. If the contract or specifications carries a guarantee or maintenance provision extending the bond beyond acceptance of the work, the undersigned agrees to pay, upon execution of the bond, and in addition to above construction premium or charge, a maintenance premium or charge of $ ..... for such term, said maintenance premiums being computed at the rate of $ ..... per $1,000 of the contract amount per annum.

Applicants Must Supply Copy of Contract, Specifications or other Documents which are referred to and made a part of the Contract.

Cont. 12000. Revised 11-15-33. Printed in U. S. A.

FIG. 1. FACSIMILE OF FIRST PAGE, APPLICATION FOR CONTRACTOR'S BOND

What are his immediate resources, his quick assets? How large are his bank loans? What are his current liabilities; what is his net worth? How does he stand with his banks, with the trade? What will his frozen assets produce on a forced sale? What credits and accommodations can he be reasonably sure of? These questions determine whether his funds are in good form, or whether it will be held necessary to conserve the funds, both present and prospective, either by the deposit of collateral, by joint control of all funds, by securing a bank commitment of credit, or by requiring the offering of an indemnitor of greater financial strength than the applicant. If the financial strength of the applicant is questionable, or if his operations are so varied or so extended as to make the future indefinite or insecure, any or several of these expedients may be resorted to as a means of making a bond otherwise satisfactory in its nature absolutely sure.

Touching one of these expedients, namely bank credits, sureties sometimes have unpleasant experiences. Often, if not always, banks loaning cash or credit to a contractor require him to make assignment of all monthly estimates as a condition incident to such loan or to such extension of bank credit. It has been held by the courts that the assignment made by the applicant to the surety on his application for a bond, takes precedence over other assignments; but there is nothing to prevent a bank from appropriating an estimate check when deposited by the contractor to his credit, or to prevent the bank from using such deposit to wipe out all, or a part of the loan made to the contractor. An incident of this character comes clearly to my mind. A long-established contracting company which had been perpetuated from father to son for many years was engaged on a large government contract. A bank with which they had had intimate business connections, and which had extended credit, in a period of great exigency applied a certain estimate check to the reduction of its loan, leaving the contracting organization without ready funds. It was only by securing the forbearance of certain creditors and the extension of increased credits by material men, that default and bankruptcy were averted. These favors were secured for the contractor by the surety as a part of the surety's services to its contractor clients.

3. *Proportions.* Having established the applicant's net worth and net liquid assets, the next problem facing the surety is the determination of the relation of such net worth to the applicant's present total financial risk, obligations, or so-called "exposure"—that is, the relation which his net liquid resources bear to the total amount of work, both bonded and unbonded, that he will have to execute if successful in this bid. In his application the applicant has fully set forth the total amount of work on his books, and the amount of such work still uncompleted. Long experience has established the rule that the amount of such uncompleted work should not be in excess of ten times the applicant's net liquid resources, or in other words that the applicant is not entitled to receive the benefit of the surety company's credit unless his net liquid assets are at least 10 per cent of his total "exposure." Because of the uncertainties and experiences incident to periods of depression, a tendency to increase this ratio has been manifested, and for certain characters of construction a relationship of 15 per cent has been demanded. The wisdom of this requirement is obvious.

The one greatest—the outstanding—defect of the contractor is his optimism. He is prone to magnify the profits and minimize the hazards. He is at heart an idealist. He loves the work to which he has dedicated his life, and above and beyond any desire for profits is the urge to be the instrumentality in the creation of some great and epochal work. The contractor looks at a blueprint and he immediately wants to be the builder. He is confident that the job will run itself and will require little or no capital for its conduct and completion. This is especially true on construction where much of the work is done under subcontracts; where the subcontractor, financing his particular part of the work, bears a considerable part of the financial hazard and burden of the general contractor. This tendency of contractors, as a class, to over-extend their obligations, is one of the most serious problems confronting the surety executives. There is no law preventing a contractor, after he has obtained his bond, from taking on more work than the ratios established by the surety companies would permit. For this reason, and for the mutual protection of applicant and surety, many surety companies, when an applicant's work approximates the ratio previously established, require him to agree not to bid upon, or to take on more work without the consent of the surety, or in advance of a substantial reduction in his total exposure.

4. *Performance.* What of the applicant's past record? What is his personal or corporate character? Has his business life been continuously clean? Does he meet his obligations promptly? What is his court record? Is he a litigant? Has he been through bankruptcy? Has a surety ever been obliged to satisfy a demand under a bond written for him? These and many other kindred facts are sifted in order to get a clear and comprehensive picture of the hazard incident to the application. Some of these facts are obtained as a result of the data set forth by the applicant in his petition. Others are secured through credit and record supply houses. By every means at its disposal the surety endeavors to get a positive "low down" on its applicant. Of course this method is not followed so completely in cases of applicants who have had long and satisfactory dealings with a particular bonding company, or whose generally high character and sound business conduct are well known on "the street." In all such investigative work, the moral hazard looms largest. An applicant may be fully able in experience and in finances to undertake and to complete a contract, but if his record is not clean then that applicant will not get a bond from a reputable bonding company. Such "unclean" applicants do sometimes get a bond, but that is because surety companies, like human beings, are fallible, and a cunning applicant can often so disguise his previous record as to deceive even the most careful underwriter.

5. *Program.* How does the applicant intend to carry out the work? What are his physical and financial plans; that is, just how carefully has he thought out and provided for the entire schedule and conduct of this contract from start to finish? How has he planned to conserve his assets and his revenues, so that there shall be no default, no shortage of funds, no unprovided-for hazards? What part will he perform first and what last? How will he coordinate the different parts in order to prevent interruptions, delays, or other difficulties? What will he perform himself; what by subcontract? These are some of the many aspects of the problem which are carefully weighed in order that, if possible, nothing shall be left to chance or to guesswork. On large undertakings, tables are prepared and careful "graphs" are made, covering the anticipated history—both physical and financial—for part or all of the life of the contract. Such a graph, covering a rather uncertain enterprise, is shown in Fig. 2. It is founded upon a table carefully worked out, indicating the curves of cash, earnings, and payments, and showing the curve of required net cash investment in comparison with that of accumulating reserve.

This chart, Fig. 2, is interesting as it gives a clear and comprehensive view of a contract during its period of probable maximum hazard. It shows diagrammatically the accumulating amounts of expenditures, earnings, payments, and reserves, from which can be produced the lines of probable maximum and minimum investment required to carry on the work. By scale measurement these amounts can be determined and plotted so as to give a graphic and clear illustration of the entire financial probabilities during the period studied.

In this particular case, earnings would equal expenditures in 8 months; payments would equal expenditures

in 16 months; on an immediate payment basis, the initial investment would be recovered in 20 months; on a deferred payment basis the initial investment would be recovered in 16 months; the reserved percentage would equal the net investment in 10 months on a deferred payment basis, and in 14 months on an immediate payment basis. The chart shows that, on the basis of the program proposed, an initial investment or net liquid assets of $260,000 would be necessary on a deferred payment basis, and $330,000 on an immediate payment basis. The term "deferred" means taking the

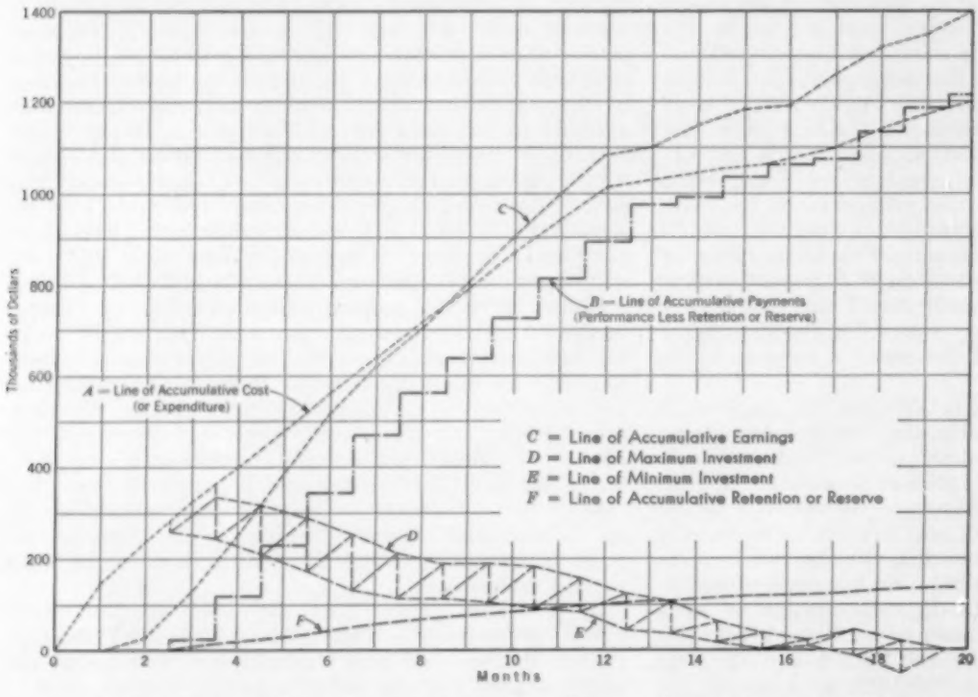

FIG. 2. PRE-BONDING GRAPH SHOWING ANTICIPATED FINANCES DURING PERIOD OF HAZARD
The Financial Hazard Is Represented by the Gap Between Line *A* and Line *B*

limit of time in meeting material bills, while "immediate" means discounting these obligations. The financial hazard of this contract is the gap between lines *A* and *B*. This gap, the surety requires, must be bridged by either cash (net liquid assets) or cash plus credits, such credits being definite and unrecallable during the life of the contract or its period of maximum hazard.

Of course this method is followed only in important cases or border-line cases, or where it is necessary in order to convince the executives of the "home offices" of the desirability of executing the bond. This evidence is offered to show that the determination of difficult matters is not left to haphazard and careless decisions or to guesswork.

6. *Personnel.* What is the applicant's organization? Who will make up his executive and superintending forces, and what has been their experience? What successes or failures have attended their previous activities? What, if any, participation have they in profits or losses? These inquiries are of obvious importance.

7. *Plant.* What means does the contractor expect to use in carrying out the enterprise? What equipment will he employ? What has he available? What will he have to purchase, and on what terms? Will the purchase of new equipment deplete his present resources or can payments safely be made from revenue? If he purposes to use present equipment, is it the best for this particular work; is it modern or obsolete, and if obsolete, will repairs eat up too large a part of the revenue? Engineering factors such as these are of vital importance to the surety in its study.

These seven cardinal points are carefully considered, weighed, and correlated. If the contractor can safely pass these tests he should be a good bonding risk.

THE TWO MOST IMPORTANT FACTORS

At this point it is pertinent to call attention to the two factors having most to do with the successful outcome of a bonding application—the broker and the underwriter. Hamlet's advice to Ophelia was "Get thee to a nunnery." But my advice to the contract applicant is "Get thee to a broker and get there quickly!" And be sure that the broker is one of the right sort—that he possesses the three cardinal virtues of pertinacity, perspicacity, and persistency. The broker is a licensed authority; his number is legion. He is a fixed and formidable part of the mechanism of suretyship, and with his help the seemingly impossible may become easy. In any event he is very useful to the applicant. There are, conservatively, 25,000 brokers in the State of New York, probably 18,000 of them in New York city.

While brokers are many, underwriters—that is, great underwriters—are few. From an acquaintance with some of the great underwriters of contract bonds, I can testify that no other position in modern business calls for such diverse abilities—such universal knowledge and equipment. The underwriter must be very much of a financier; he must be able to determine quickly and accurately the financial strength or weakness of an applicant, not altogether from what the applicant says, but from his own extensive knowledge of what may be the good or bad features of the applicant's financial position. His perception of and reactions to business trends and credit possibilities must be clear and wise. He must be able to construct such an accurate financial horoscope of every offering, that it will not, like Banquo's ghost, rise up to ruin his own future.

Then he must be very much of a contractor. Not that he should be able to handle men and machinery, or any other of the complicated problems daily arising in the administration of contract work, but he must have a sufficiently intimate knowledge of contracts, costs, operations, and hazards as to see the contract clearly, as a whole and in detail, throughout its life, or at least during the hazardous period of the bond. Aware that his client is usually if not always the lowest bidder, he must be able to see the reasonableness of the low bid; he must not be stampeded by enthusiasm nor put to rout by others' doubts.

Next, he must be in considerable measure a lawyer, and a good lawyer. In his consideration of contracts, trick phrases or nice distinctions in phraseology are constantly being encountered. Again, in the preparation of bonds he must carefully weigh and specify just what the obligation is which he is accepting; just what is covered and what is not; just how long the obligation is to exist; and innumerable similar matters. Again, he is often required to draft agreements relating to joint control, collateral, and other matters—all of which require extensive and intimate knowledge of legal practices, proceedings, and verbiage.

Lastly, he must be very much a detective. It is his function to discover what has not been disclosed, to get the facts that may have been hidden or distorted, to corroborate or disprove—and to be positively sure about it.

All these things he must be with a single purpose—to write a bond if the applicant is entitled to a bond. He must not be swayed by any personal attractions or repulsions. He must have an open mind but not a gullible one. It is easy to say "no." The great underwriter is he who can say "yes," and show by the clear and convincing array of facts which his underwriting memorandum sets forth, and by the favorable outcome of his underwritings, that "yes" is very often the proper answer to a difficult problem.

BORDER-LINE CASES CONSIDERED

This brings us quite naturally to a consideration of the sharp distinction between border-line cases and what I would call "office-boy underwriting." Many a bond can be executed by the office boy with a rubber stamp quite as well as by the high-salaried underwriter. It is in border-line cases that the science of underwriting lies; it is these that show the real stature and mettle of the underwriter. As an instance, I recall a case that arose in the earlier days of bond underwriting on New York City subway contracts. A new firm was the successful bidder on a large and important contract. "The street" said "no"—and made that "no" emphatic. The case seemed hopeless. An outstanding underwriter whipped the presentation into shape and the bond was written without a penny's loss to the associated sureties—which leads me to say what I should have said when discussing the qualifications of an underwriter, that he should be a great pleader, an advocate. When once convinced that an offering is rightly entitled to be bonded, he should be able, and if he is equal to his job he is able, to convince others of the correctness of his reasoning and conclusions. He must not only be convinced but convincing. From the foregoing I think it will be admitted that a great underwriter is an exceedingly well-equipped and capable person, as well as a very rare person.

It is in connection with border-line projects that one hears so often the term "irresponsible contractor." Two instances will supplement the case already cited. Several years ago, a man now recognized as one of the outstanding contractors of the country was completing a railroad in a central state. He ordered his storehouse keeper to return the unused materials for credit to the supply houses whence they had come. The storehouse keeper questioned the wisdom of such returns to certain supply firms, whereupon the contractor said, "You just paste a copy of our present financial statement on the head of those barrels, and I'll guarantee that they will be very glad to take them back." And he was right. "Irresponsibility" is largely youth and scanty funds.

A firm of young men, just organized, came to an underwriter, a Nestor of the bonding forces of New York, for a bond—their first. They had little experience and less cash. By all the laws of underwriting they were not entitled to a bond. But this underwriter, acting on a "hunch," and because of the quality of manhood displayed, took a chance. Today they are as sound as Gibraltar, preferential contractors on large railroad jobs.

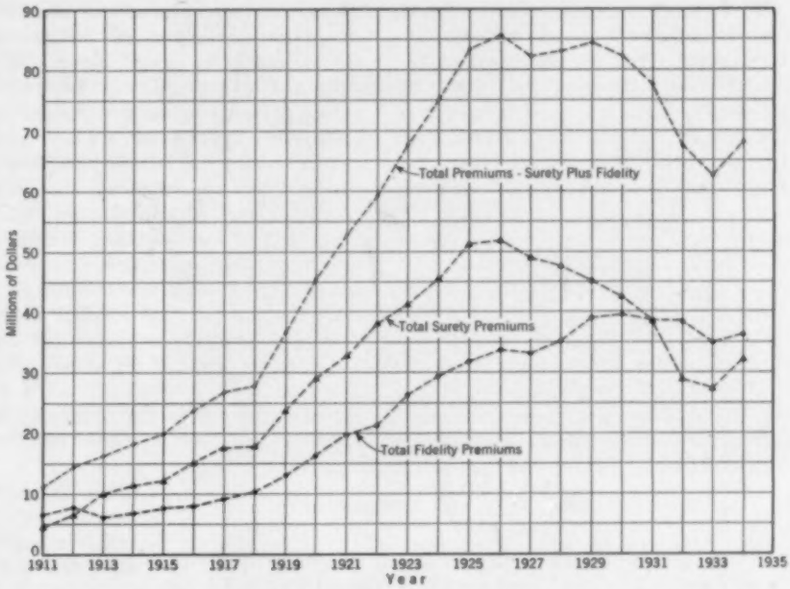

FIG. 3. CHART SHOWING HISTORY OF SURETY AND FIDELITY PREMIUMS OF THIRTY SURETY COMPANIES

This Chart Indicates That the Business Depression Really Began in 1925

Such instances could be multiplied, not to sanction careless underwriting but to illustrate the wisdom and common sense exercised by sound underwriters, and at the same time to discourage the too frequent use of an epithet such as "irresponsible." The "irresponsible" engineer, like the "irresponsible" contractor, is often the one who has not had an opportunity to show what is in him.

Figure 3 is a graph which illustrates the premium history of bonding, as related to some thirty of the most prominent of the surety companies during the last 24 years, and confined to surety and fidelity, the two items which make up the distinct "bonding" feature of such companies. This graph is very interesting when considered in its relation to the present era of continued business depression. It indicates that construction in the year 1933 was on the same level as that of 1920. It also indicates that the slump had really started in 1925, some three or four years before it was generally recognized that the "bottom had dropped out of business." It likewise shows that, so far as "bonding" is concerned, the real slump is in construction, or contract bonds; fidelities (instruments guaranteeing integrity) have maintained themselves practically without serious decline during this sag in the business curve. I am confident there is no better barometer of business conditions, both existing and to be anticipated, than charts of such collateral and non-initiative enterprises as suretyship.

Torsional Rigidity of Structural Sections

A Method of Determining This Property by the Soap Film Analogy

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IN the April 1935 issue of "Proceedings" there appeared the results of an interesting study of the torsional properties of standard structural sections, made by Inge Lyse, M. Am. Soc. C.E., and Mr. Johnston. That investigation had been supplemented by soap film experiments, as well as by actual torsion tests, but the resulting paper did not discuss in detail the soap film work. This Mr. Johnston has ably presented in the following article, which describes the apparatus and procedure used in the study above-mentioned, to develop by means of Prandtl's membrane analogy, general formulas for the torsional constant of structural shapes. This work was conducted as a regular research project of the Fritz engineering laboratory at Lehigh University.

WHEN a shaft of circular cross section is twisted, a section that was plane before twisting remains very nearly plane. Internal resistance to the twist of the shaft is maintained by shearing stresses which are proportional to the distance from the center line of the shaft. The total resisting moment may be expressed as:

$$T = JG\theta \quad \ldots\ldots [1]$$

in which T = torsional moment in inch-pounds
J = polar moment of inertia
G = shearing modulus
θ = angle of twist in radians per inch

At any distance, c, from the center line of the shaft, the shearing stress is:

$$\tau = \frac{Tc}{J} \quad \ldots\ldots [2]$$

These simple relationships between torsional moment, twisting deformation, and shearing stress only hold for circular sections. In a shaft of any other cross section, a plane section warps during twisting, and the polar moment of inertia of the section has, in general, no direct relation to the torsional problem. It is possible, however, to determine either mathematically or experimentally a torsion constant which may be substituted for J in Eq. 1. Denoting the torsion constant by K, then:

$$T = KG\theta \quad \ldots\ldots [3]$$

and the torsional shearing stress at any point in a non-circular section is proportional to $\frac{T}{K}$ multiplied by some function of the thickness of the material at the point in question. It is of primary importance, in designing any non-circular section for torsion, to be able to calculate the torsion constant.

Treatises on the torsion problem show that a general analysis involves the solution of a partial differential equation, which may be written in the following form:

$$\frac{\partial^2\phi}{\partial x^2} + \frac{\partial^2\phi}{\partial y^2} = -2G\theta \quad \ldots\ldots [4]$$

In this equation, ϕ is a torsional stress function in terms of the coordinate axes of the section under consideration. Saint Venant[1] was the first to develop correctly the general solution of the torsion problem, finding the torsion constant and stress distribution in such shapes as the ellipse, rectangle, square, and triangle.

EXPLANATION OF MEMBRANE ANALOGY

In 1903, Prandtl[2] showed that the general equations applicable to the torsion problem could be satisfied mechanically by stretching a thin membrane across an opening having the same shape as the section to be investigated and distending the membrane by a slight variation in pressure. The membrane analogy was first used successfully by Griffith and Taylor[3] and later by Trayer and March,[4] both investigations dealing with sections common in aircraft construction.

In developing the theory of the membrane analogy it is assumed that the tension in the soap bubble film, Fig. 1, is the same in all directions and that it is independent of location or shape. It is further assumed that the uniform pressure under the film acts in a direction parallel with the z axis rather than normal to the surface of the film. This assumption is relatively true if the bubble is distended only a slight amount. It can then be shown, by considering the equilibrium of a small part of the film, that the equation of the surface of the film is:[2,5]

$$\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} = -\frac{p}{F} \quad \ldots\ldots [5]$$

In this case, z, x, and y = rectangular coordinates
p = unit pressure under the film
F = unit tensile force in the film

The similarity between Equations 5 and 4 makes evident the analogy between the distended membrane and the torsion problem. Prandtl showed that the torsional rigidity, K, is proportional to the total volume of the displaced bubble; that the torsional shearing stress at any point on the cross section is proportional to the maximum slope of the bubble at that point; and that contour lines on the bubble represent the direction of maximum shearing stress.

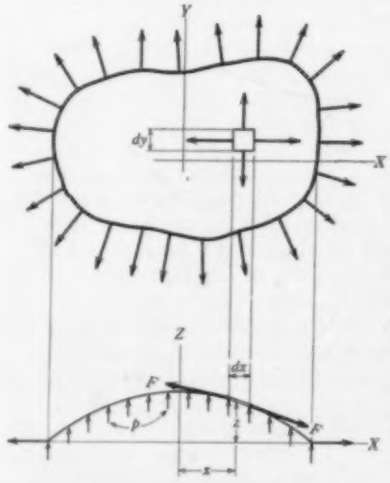

FIG. 1. FORCES IN A DISTENDED SOAP FILM

Based on the Assumption That Tension Is the Same in All Directions and That Pressure Under the Film Acts Parallel with the Z-Axis

The possibilities of error in using this analogy arise

both from the assumptions made in the derivation and from difficulties encountered in the actual application. The derivation of the soap film analogy is dependent on the fact that for small angles the sine is nearly equal to the tangent. The deviation of sine from tangent increases with increased inclination of film surface, and the results are affected in two different ways: First, by the assumption that the sine is equal to the tangent, and second, by the assumption that the pressure on the film was parallel with the Z-axis. While these two errors partially offset each other, the net error for a given non-circular section is not readily calculable as a function of average film slope. In actual application, the error is minimized by using a circular section beside the section under study as an index of comparison, making it possible to obtain directly the unknown torsional properties from the slope and volume ratios of the two bubbles.

In the study of structural sections at Lehigh University, elsewhere referred to, fifty-seven differently proportioned H-beam and I-beam shapes were tested by means of the membrane analogy. Only volume measurements were made, as it was the purpose of the series to establish formulas for the torsion constant. Four standard circular-hole sections were made with varying diameters, and these were calibrated against each other and against rectangular and square sections of known torsional properties. A calibration curve, made from the results of thirty such tests, provided both for correcting theoretical errors and for volume and pressure changes which occurred during direct volume measurements.

Several different techniques or methods have been used by investigators in applying the membrane analogy to torsion. An air-tight box is generally used as a base, over which is clamped an aluminum or brass plate in which a hole has been cut to reproduce the section of the member to be studied, with a circular hole to serve as the comparison index. A film of soap solution is then spread over the holes and enough air is introduced into the compartment below to give the bubbles a convexity of the desired degree. Measurements are than taken of volumes and slopes, as required by the nature of the problem.

CHARACTERISTICS OF A SUITABLE SOAP SOLUTION

A soap film for use in membrane analogy experiments must be tough and durable and of such consistency that it will maintain a uniform thickness. The composition of soap films has been the subject of considerable investigation, and reference may be made to the work of Sir James Dewar,[6] a pioneer in this field. Trayer and March[4] tried out several compositions and finally obtained best results with a Dewar solution made of "a very small quantity of triethylamine oleate added to a fifty per cent solution of glycerin in distilled water." In the present work the following solution was used:

Triethynolamin oleate.....	10 per cent
Glycerin.....	30 per cent
Water.....	60 per cent

The proportions are by weight. The triethynolamin oleate is less expensive than the oleate used by Trayer and March but gave very satisfactory results in the work here described. Some of the films lasted for three or four days after having been subjected to test.

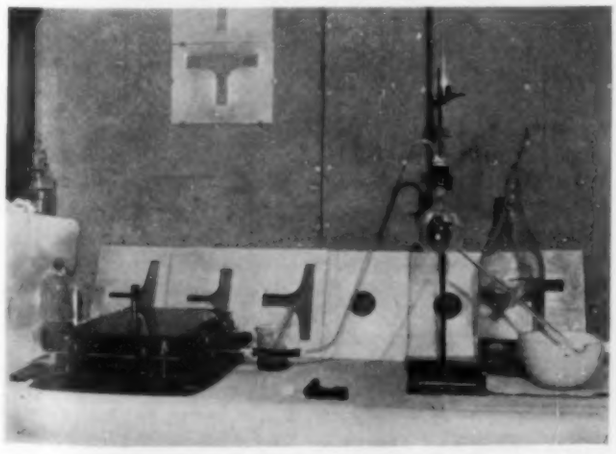

FIG. 2. GENERAL VIEW OF TESTING APPARATUS

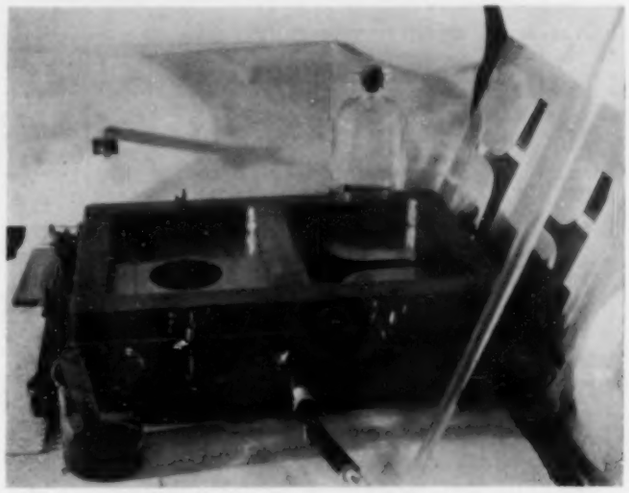

FIG. 3. RECEPTACLE FOR HOLDING SOAP FILMS

The soap solution must be kept in an air-tight container and should be used only under conditions of constant temperature. Loss of water by evaporation will change the consistency of the film and the corresponding tensile force which it develops. Precautions should be taken to see that no grease or acid contaminates the film, as these will alter its properties and shorten its life.

METHOD OF MEASURING VOLUMES

The volume of the circular index bubble may be calculated on the basis of its being a spherical segment from direct observations of its altitude made with a micrometer screw suspended over the center of the bubble and supported on a suitable frame.

In previous investigations, the volume of the test bubble was usually established indirectly by means of contour-line plotting. A pointed micrometer, held in an adjustable sliding frame over the bubble, was lowered until the point just touched the surface at any desired height. A pencil attached to the upper end of the micrometer traced off the contour lines on a drawing board as the point was moved around the bubble. The volume was then calculated by planimetering the contour-line areas at equal height increments.

This method has the advantage of reproducing directly the stress lines of the section and also affords a means of plotting vertical sections from which the slopes of the bubbles may be approximately determined and shearing stress values calculated. The disadvantages are that the accuracy of the results is dependent on a double measurement involving the repeated use of micrometer and planimeter, and a large amount of time is required both in observation and calculation.

In the present study, the volume was determined by measuring directly the total displacement of the two bubbles and subtracting from the total increase in volume the calculated volume of the circular bubble. Water from a burette, shown in Fig. 2, was introduced into an air-tight flask which served as a displacement chamber. The air from this chamber entered a compartment under the soap films to "blow" the bubbles to the desired height. The total volume of water introduced was not

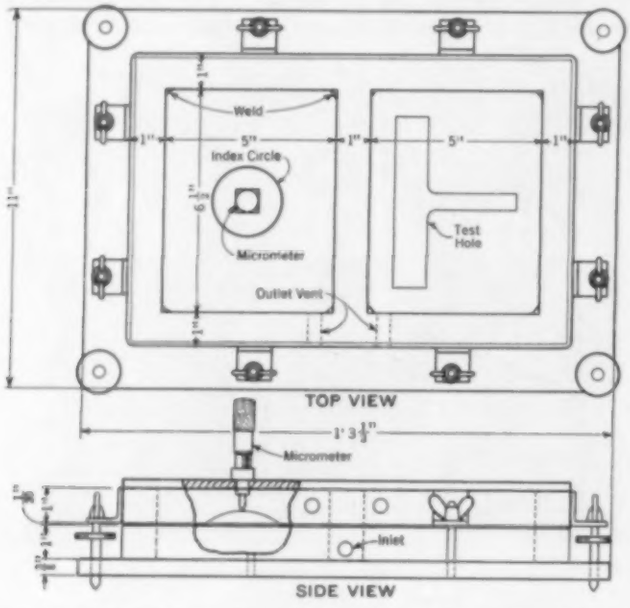

FIG. 4. DETAIL OF RECEPTACLE FOR HOLDING SOAP FILMS

exactly equal to the total volume of the two bubbles because of the slight increase in pressure in the compartment. The discrepancy was taken care of by an experimentally determined correction or calibration curve made between sections of known torsional properties.

The direct method here described has the advantages of speed and accuracy, but gives no information as to the magnitude or direction of stress. It is believed, however, that the most important application of the analogy is in determining the torsion constant of any section and that the importance of the theoretical stresses depends on the degree to which they are localized and the ductility of the material. These factors can only be determined by actual torsion tests.

DESCRIPTION OF THE APPARATUS USED

A general view of the apparatus set up for operation is shown in Fig. 2. The displacement chamber was made with a 250-cc flask, to the bottom of which was welded a drainage tube with a stop-cock. A two-hole rubber cork in the top of the flask received a 50-cc burette, graduated to 0.1 cc, and a glass tube for transmitting air to the box.

The receptacle for holding the soap films is shown in Fig. 3 and detailed in Fig. 4. The lower part consists of a flat plate to which is soldered the double box frame made of bars 1 in. square, welded together. Thumb screws in each of the four corners provide a means of supporting and leveling the apparatus. Eight stud bolts are fitted in the plate to receive and tighten down the upper box with wing nuts and washers. The entry tube for the air is of brass, screw-threaded at the end to enter a tapped hole in the lower frame. The air had free access to both lower chambers by means of a recess in the end of the lower-frame center-piece. The top of the lower frame is machined to receive the two aluminum test pieces. The detachable upper frame is made the same shape as the lower part and is machined on both faces. All joints in the apparatus were sealed. Over the upper chamber rested a removable section of plate glass $\frac{1}{4}$ in. thick, fitted with a pointed micrometer for measuring the height of the circular bubble.

Stock aluminum sheets 0.05 in. thick were used for the plates. The holes were laid out with a scribe and roughed in with a power jig-saw. Small steel files were used to cut close to the line, and the final shaping was done with fine emery cloth. The under side of the cuts was beveled in order to prevent the edge of the soap film from dropping below the upper surface of the plate. The bevel was made at an angle of 45 deg. and was brought nearly up to meet the upper surface.

PROCEDURE IN MAKING TESTS

In making the tests, the following order of procedure was followed:

1. A continuous coating of clean, hard grease was placed on the upper surface of the lower frame. The aluminum test pieces were clamped into position with even pressure.
2. The level and alignment of the plates were checked with a small spirit level and with a micrometer.
3. All grease was wiped from the surfaces of the aluminum plates.
4. An even layer of soap film was stretched across the holes by means of a smooth piece of celluloid or bakelite which had received an even distribution of the soap solution along its lower part.
5. Surplus drops of solution were drained from the films.
6. A drop of soap solution was applied to the point of the micrometer measuring screw, and the glass cover was set in place.

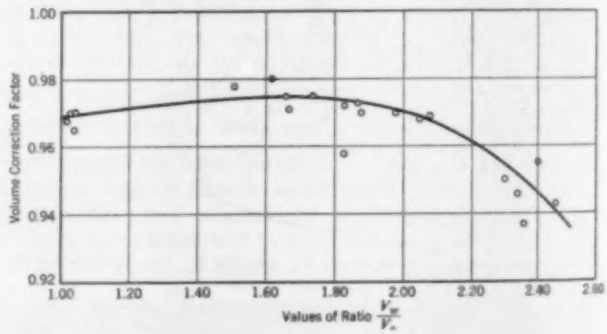

FIG. 5. CALIBRATION CURVE FOR OBTAINING VOLUME CORRECTION FACTOR

Corrections for Theoretical Errors and Volume and Pressure Changes Were Made by the Use of This Curve

7. The micrometer was set at the elevation desired for the initial reading, which should give the bubble a slight upward curvature.
8. Water was slowly introduced from the burette until the soap film just touched and ran up on the point of the micrometer screw. This procedure gave results accurate to ± 0.001 in.
9. The burette reading was recorded, estimating to the nearest 0.01 cc.
10. The micrometer screw was set in position for the final reading and operation No. 8 was repeated.
11. The final reading of the burette was recorded.

The following precautions were observed throughout the progress of the work:

1. The room and all parts of the apparatus were kept at constant temperature. As aids to this end, the glass parts of the apparatus were not contacted by the hands more frequently than essential to the test. Further, the water in the burette and flask were mixed before use, in order to equalize their temperature.
2. The tightness of the apparatus and the constancy of the temperature were checked by blowing a bubble to a definite height and observing its behavior over a period of time.
3. All parts of the apparatus were kept free from grease and acid. Whenever the bubbles burst quickly, all apparatus was cleaned a second time. Acidity may be caused by an excess of carbon dioxide in the atmosphere.
4. To insure uniformity of pressure change, each test in any series was started with the water level in the displacement flask at about the same height.

TEST RECORDS AND CALCULATIONS

The calibration curve, based on tests between sections of known torsional properties, is shown in Fig. 5 for one of the soap solutions used in the tests. The ordinates represent factors by which the total volume of water introduced from the burette is multiplied to obtain the actual total volume of the two bubbles. The abscissas represent ratios of the total volume of water to the volume of the circular test bubble. It seems desirable to use a circular section of such diameter as to keep $\frac{V_w}{V}$ below 2.00, as this will give a correction factor which is very nearly constant. For a solution of any given consistency, the pressure correction curve will vary—hence the importance of maintaining the composition of the soap film solution and the temperature of the room constant throughout any series of tests.

A sample order of computation for a typical test follows:

Diameter of test circle	2.100 in.
J = polar moment of inertia of circle	1.909 in.
V_w = volume of water drawn from burette (average of three tests which check closely)	10.82 cc
V_c = volume of circular bubble calculated from altitudes	5.90 cc
$\frac{V_w}{V_c}$ =	1.84
Correction factor (Fig. 5) =	0.973
V_b = total volume of bubbles = 0.973 × 10.82 =	10.53 cc
V_t = volume of test section bubble = 10.53 − 5.90 =	4.63 cc
$\frac{V_t}{V_c}$ =	0.785
K = torsion constant of test section = 0.785 × 1.909 =	1.499 in.[4]

The manner in which the results of the tests at Lehigh University were used to develop general formulas for the torsion constant of structural sections has been described in "Structural Beams in Torsion," which appeared in PROCEEDINGS for April 1935. Acknowledgment is made to Professors Inge Lyse and Joseph B. Reynolds, of Lehigh University, whose assistance and guidance made this work possible.

REFERENCES

(1) Navier. *Résumé des Leçons*, 3d ed., edited with notes and appendices by Saint Venant, 1864.
(2) Prandtl, L. "Zur Torsion von Prismatischen Staben," *Physikalische Zeitschrift*, IV, 1903, p. 758.
(3) Griffith, A. A., and Taylor, G. I. *Technical Reports of the Advisory Committee for Aeronautics, No. 333*, June 1917.
(4) Trayer, G. W., and March, H. W. *The Torsion of Members Having Sections Common in Aircraft Construction*, Report No. 334, National Committee for Aeronautics.
(5) Timoshenko, S. *Theory of Elasticity*, Chapter 9.
(6) Dewar, Sir James. *Collected Papers of Sir James Dewar*, Volume II, Article 248.

ENGINEERS' NOTEBOOK

From everyday experience engineers gather a store of knowledge on which they depend for growth as individuals and as a profession. This department, designed to contain practical or ingenious suggestions from engineers both young and old, should prove helpful in the solution of many troublesome problems.

Problems Requiring Integral Values of Variables

By GEORGE J. VIERTEL, JUN. AM. SOC. C.E.

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OCCASIONALLY an engineer is confronted with a problem involving n unknowns with only $n-1$ relations between them. If the problem inherently requires an integral answer, a finite number of solutions can easily be obtained by the method described here. From among these the most probable answer for a particular case can be selected by consideration of other known facts.

The method can be explained best by solving a simple example. Let us assume that there is a total quantity of 118 anchors in a lot, the total cost of which is $16.48. The anchors are of three types, the unit costs of the several types being respectively 8, 22, and 14 cents. The problem is to determine the number of each type of anchor in the lot.

Let x represent the number of anchors of the first type, y that of the second, and z that of the third. We can set up only two equations containing the three unknowns:

$$8x + 22y + 14z = 1{,}648 \quad [1]$$

$$x + y + z = 118 \quad [2]$$

Eliminating x between Eqs. 1 and 2, we have

$$14y + 6z = 704 \quad [3]$$

a single equation in two unknowns. If Eq. 3 is divided

by the coefficient of z and transposed, there results

$$z + \frac{14\,y}{6} - \frac{704}{6} = 0 \quad . \quad . \quad . \quad . \quad . \quad . \quad [4]$$

which may be written as

$$z + 2\,y + \frac{2}{6}\,y - 117 - \frac{2}{6} = 0 \quad . \quad . \quad . \quad . \quad . \quad [5]$$

Combining the terms with fractions, factoring out the largest possible fraction, and reducing the latter to its lowest terms, we have

$$z + 2\,y - 117 + \frac{1}{3}\,(y - 1) = 0 \quad . \quad . \quad . \quad [6]$$

The problem now is to determine values of y for which the term containing the fraction is integral. This is done by equating the parenthesis to the denominator of the fraction, or a multiple thereof:

$$y - 1 = 3;\ y = 4.$$

Substituting this value of y in Eq. 3, $z = 108$. Then from Eq. 2, $x = 6$. These values must also satisfy Eq. 1.

We now have one set of integral values of the variables which satisfies the conditions of the problem. Other combinations can be obtained by equating the parenthetical expression $(y - 1)$, Eq. 6, to other multiples of the denominator, 3, such as 0, 6, 9, 12, and following the same subsequent procedure as before. Table I shows all combinations which satisfy the conditions of Eqs. 1 and 2, and also have positive values for x, y, and z.

From the table it will be noted that there is a straight-line change in the values of x, y, and z if plotted against

TABLE I. INTEGRAL VALUES OF x, y, AND z SATISFYING THE GIVEN EQUATIONS

LINE NO.	(MULTIPLE OF 3) $= (y - 1)$	x	y	z
1	0	2	1	115
2	3	6	4	108
3	6	10	7	101
4	9	14	10	94
5	12	18	13	87
6	15	22	16	80
7	18	26	19	73
8	21	30	22	66
9	24	34	25	59
10	27	38	28	52
11	30	42	31	45
12	33	46	34	38
13	36	50	37	31
14	39	54	40	24
15	42	58	43	17
16	45	62	46	10
17	48	66	49	3

the column headed "(Multiple of 3) $= (y - 1)$." Therefore all possible values satisfying the conditions of the problem may be obtained either by the algebraic method exclusively, or by solving algebraically for two sets of values, and interpolating.

The most probable answer in a specific case would be that which other known facts indicate to be correct. For example, if it is known in the problem illustrated that there is about the same quantity of each type of anchor in the lot, the most probable answer would be that of line No. 12 of the table.

Functions of Beam with Equally Spaced Concentrated Loads

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MOMENTS, slopes, and deflections of beams carrying a number of equal concentrated loads equally spaced along the span must frequently be computed in designing such structural members as purlins carrying rafters or girders supporting cross beams. General formulas to simplify such computations both for simply supported and for rigidly fixed beams, are presented herewith in Table I.

TABLE I. FORMULAS FOR VARIOUS FUNCTIONS OF BEAMS WITH EQUAL CONCENTRATED LOADS UNIFORMLY SPACED

TYPE OF END SUPPORT	FUNCTIONS	WHEN N IS EVEN	WHEN N IS ODD
Freely supported	Max. positive moment at center; lb-in.	$\frac{N}{8}\,PL$	$\frac{(N^2 - 1)}{8\,N}\,PL$
	Max. deflection at center, inches	$\frac{(5\,N^2 - 4)}{384\,N}\,\frac{PL^3}{EI}$	$\frac{(5\,N^4 - 4\,N^2 - 1)}{384\,N^3}\,\frac{PL^3}{EI}$
	Slope (in radians) at supports	$\frac{(N^2 - 1)}{24\,N}\,\frac{PL^2}{EI}$	$\frac{(N^2 - 1)}{24\,N}\,\frac{PL^2}{EI}$
Rigidly fixed	Max. positive moment at center, lb-in.	$\frac{(N^2 + 2)}{24\,N}\,PL$	$\frac{(N^2 - 1)}{24\,N}\,PL$
	Max. negative moment at supports, lb-in.	$\frac{(N^2 - 1)}{12\,N}\,PL$	$\frac{(N^2 - 1)}{12\,N}\,PL$
	Max. deflection at center, inches	$\frac{N}{384}\,\frac{PL^3}{EI}$	$\frac{(N^4 - 1)}{384\,N^3}\,\frac{PL^3}{EI}$

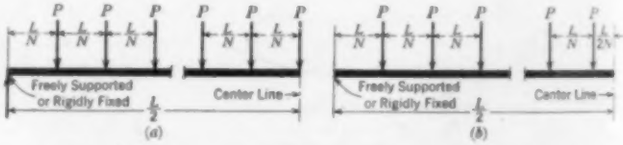

FIG. 1. BEAM WITH EQUAL CONCENTRATED LOADS EQUALLY SPACED

(*a*) When N Is Even (*b*) When N Is Odd

The following notation is used:

- L = span length of beam, in inches
- EI = flexural rigidity of beam; E is in pounds per square inch, and I in inches to the fourth power
- P = one of the concentrated loads, in pounds
- N = number of spacings (that is, number of concentrated loads plus 1)

Two cases are distinguished—one in which N is an even number (Fig. 1 *a*), and the other in which N is odd (Fig. 1 *b*). The table is self-explanatory.

EDITOR'S NOTE: *In order that it may be available for ready reference, a discussion of the development of these formulas is published elsewhere in this issue.*

Easy Design of Eccentric Riveted Connections

By JOHN KRIPPNER

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A SHORT, direct way of designing eccentric riveted connections would be very desirable in practice. The problem, however, is not so easy of general solution. There are principally four variables that enter into it—the load, the eccentricity, the value of the rivet, and the pitch of the rivets. Of these, the pitch is the most important in practice, as every size of rivet requires a certain minimum pitch to prevent injury to the material. It would therefore seem appropriate to prepare a set of curves that would be independent of the rivet pitch and that could be used with any size of rivet.

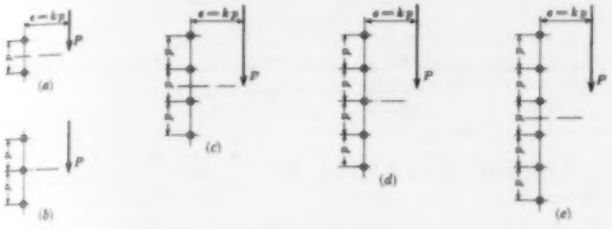

FIG. 1. CONNECTIONS WITH A SINGLE ROW OF RIVETS

How this can be done for one and two rows of rivets is here shown. By extending the same line of reasoning to three, four, five, or six rows of rivets, a general solution may be arrived at that will cover any case of eccentric connection encountered in practice.

In the formulas the following notation has been used:

P = total load in pounds
e = eccentricity of load, in inches
p = rivet pitch, in inches
$k = \frac{e}{p}$
R = value of rivet (maximum permissible total stress on any one rivet) = S_T
I = polar moment of inertia of the group of rivets about its center of gravity = $\Sigma x^2 + \Sigma y^2$

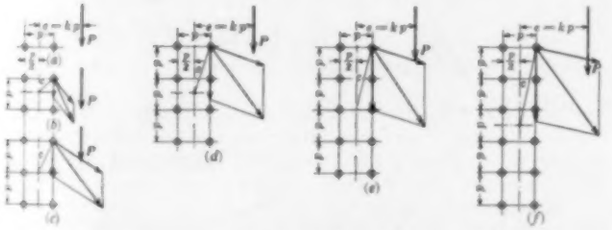

FIG. 2. CONNECTIONS WITH TWO ROWS OF RIVETS

c = distance from center of gravity of the group to the most remote rivet
I/c = section modulus of the group, in inches
S_D = direct stress on each rivet
S_M = moment stress on extreme rivet
S_T = total stress on extreme rivet

DERIVATION OF FORMULAS

Case 1. One row of rivets, 2 rivets total (Fig. 1 *a*). The direct stress is assumed to be divided equally among all rivets in the connection. In this case, therefore, $S_D = \frac{P}{2}$. Leaving out of account the area of the rivets, the polar moment of inertia of the group is $2\left(\frac{p}{2}\right)^2$, or $\frac{p^2}{2}$. Dividing by the distance from the center of gravity of the group to the most distant rivet gives $\frac{I}{c} = p$, and the moment stress on the extreme rivet is $S_M = \frac{Pkp}{p}$ or Pk. In a connection consisting of a single row of rivets the direct stress and the stress due to moment are at right angles, so $S_T = \left[\left(\frac{P}{2}\right)^2 + (Pk)^2\right]^{1/2}$. Setting this equal to R, the maximum permissible stress on any one rivet, squaring, and dividing by P^2, there results

$$\left(\frac{R}{P}\right)^2 = k^2 + \frac{1}{4} \quad \ldots\ldots\ldots [1]$$

The equations given below for connections with more than two rivets are derived similarly.

Case 2: One row of rivets, 3 rivets total (Fig. 1 *b*).

$$\left(\frac{R}{P}\right)^2 = \frac{k^2}{4} + \frac{1}{9} \quad \ldots\ldots\ldots [2]$$

Case 3: One row of rivets, 4 rivets total (Fig. 1*c*).

$$\left(\frac{R}{P}\right)^2 = \frac{9}{100}k^2 + \frac{1}{16} \quad \ldots\ldots\ldots [3]$$

Case 4: One row of rivets, 5 rivets total (Fig. 1 *d*).

$$\left(\frac{R}{P}\right)^2 = \frac{k^2}{25} + \frac{1}{25} \quad \ldots\ldots\ldots [4]$$

Case 5: One row of rivets, 6 rivets total (Fig. 1 *e*).

$$\left(\frac{R}{P}\right)^2 = \frac{k^2}{49} + \frac{1}{36} \quad \ldots\ldots\ldots [5]$$

For two-row connections, the direct and moment stresses are not at right angles, and the development of the equations must be modified accordingly.

Case 6: Two rows of rivets, 2 rivets total (Fig. 2 *a*).

$$S_D = \frac{P}{2}, \frac{I}{c} = \frac{\left(\frac{p}{2}\right)^2 2}{\frac{p}{2}} = p, S_M = \frac{Pkp}{p} = Pk.$$

Here moment stress and direct stress are collinear,

$$S_T = \frac{P}{2} + Pk = R, \text{ and}$$

$$\left(\frac{R}{P}\right)^2 = k^2 + k + \frac{1}{4} \quad \ldots\ldots\ldots [6]$$

Case 7: Two rows of rivets, 4 rivets total (Fig. 2 *b*).

$$S_D = \frac{P}{4}, \quad I = (\tfrac{1}{2})^2 8p^2 = 2p^2, c = [(\tfrac{1}{2}p)^2 2]^{1/2} = 0.707\,p,$$

$$\frac{I}{c} = \frac{2p^2}{0.707\,p} = 2.83\,p, \quad S_M = \frac{Pk}{2.83} = 0.354\,Pk, \text{ and}$$

$$S_T = \left[\left(\frac{P}{4}\right)^2 + (0.354\,Pk)^2 + \frac{2P}{4} \times 0.354\,Pk \times \tfrac{1}{2} \times \frac{1}{0.707}\right]^{\frac{1}{2}} = R.$$

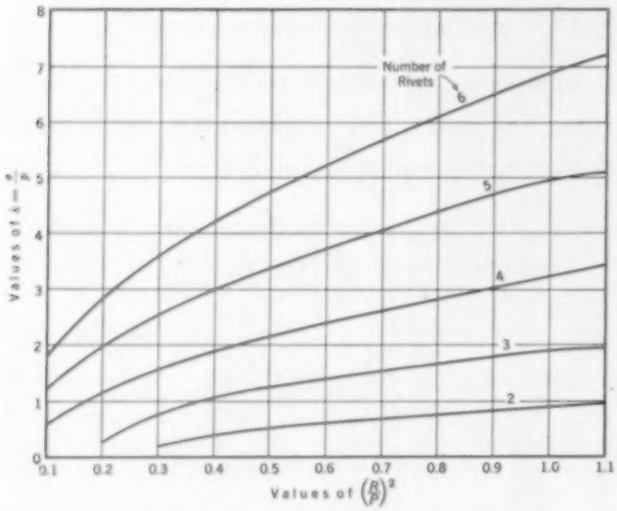

FIG. 3. CHART FOR DETERMINING REQUIRED NUMBER OF RIVETS IN SINGLE-ROW CONNECTIONS

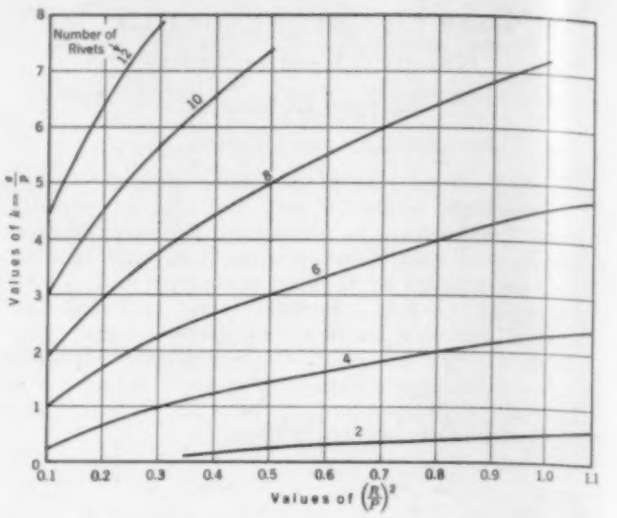

FIG. 4. CHART FOR DETERMINING REQUIRED NUMBER OF RIVETS IN TWO-ROW CONNECTIONS

$$\left(\frac{R}{P}\right)^2 = 0.125\,k^2 + 0.125\,k + 0.0625 \quad . \quad . \quad . \quad [7]$$

Attention is called to the fact that, in combining direct stress with moment stress, the principle on page 837 of Eugene A. Dubin's paper, "Eccentric Riveted Connections," in PROCEEDINGS for August 1934, has been applied. The more familiar trigonometric formula, $a^2 = b^2 + c^2 - 2bc \cos A$, may be used instead, in which

$a = S_T$, $b = S_D$, and $c = S_M$.

The angle whose cosine is $\frac{\frac{p}{2}}{c}$ is $180° - A$, so

$$\cos A = \frac{-\frac{p}{2}}{c} = -\left(\frac{1}{2} \times \frac{1}{0.707}\right).$$

Case 8: Two rows of rivets, 6 rivets total (Fig. 2*c*).

$$\left(\frac{R}{P}\right)^2 = 0.0416\,k^2 + 0.0304\,k + 0.0278 \quad . \quad . \quad . \quad [8]$$

Case 9: Two rows of rivets, 8 rivets total (Fig. 2*d*).

$$\left(\frac{R}{P}\right)^2 = 0.0174\,k^2 + 0.0104\,k + 0.0156 \quad . \quad . \quad [9]$$

Case 10: Two rows of rivets, 10 rivets total (Fig. 2*e*).

$$\left(\frac{R}{P}\right)^2 = 0.00842\,k^2 + 0.00446\,k + 0.01 \quad . \quad . \quad [10]$$

Case 11: Two rows of rivets, 12 rivets total (Fig. 2*f*).

$$\left(\frac{R}{P}\right)^2 = 0.00452\,k^2 + 0.0022\,k + 0.00695 \quad . \quad . \quad [11]$$

PRACTICAL APPLICATIONS

Equations 1 to 5 are plotted in Fig. 3, and Eqs. 6 to 11 in Fig. 4. Their use will now be demonstrated by applying them to a simple design problem.

Problem 1(*a*): How many $^3/_4$-in. rivets are required to carry a load of 10,000 lb with an eccentricity of 9 in. if the rivet pitch is $2^3/_4$ in.?

Solution: $p = 2.75$ in., $k = \frac{e}{p} = \frac{9}{2.75} = 3.46$, $R =$ 5,300 lb, $P = 10{,}000$ lb, $\left(\frac{R}{P}\right)^2 = 0.28$.

Entering Fig. 1 with these values of k and $\left(\frac{R}{P}\right)^2$, we find that in a single-row connection 6 rivets are required. In Fig. 2 we find similarly that a two-row connection requires a total of 8 rivets.

Problem 1(*b*): Same as 1(*a*) except that $^7/_8$-in. rivets are used with 3-in. pitch.

Solution: $p = 3$ in., $k = \frac{e}{p} = \frac{9}{3} = 3$, $R = 7{,}220$, $P = 10{,}000$, $\left(\frac{R}{P}\right)^2 = 0.52$.

With these values of k and $\left(\frac{R}{P}\right)^2$ we find it takes five $^7/_8$-in. rivets in single row, or six $^7/_8$-in. rivets in two rows of 3 each.

Problem 1(*c*): Same as 1(*a*) except that 1-in. rivets are used with $3^1/_2$-in. pitch.

Solution: $p = 3^1/_2$ in., $k = \frac{e}{p} = \frac{9}{3.5} = 2.57$, $R =$ 9,420, $P = 10{,}000$, $\left(\frac{R}{P}\right)^2 = 0.89$. For these values of k and $\left(\frac{R}{P}\right)^2$ we find that four 1-in. rivets, in single row, or six 1-in. rivets in double row will be required.

If, however, the pitch were changed to 5 in., we would have $k = \frac{9}{5} = 1.8$, and $\left(\frac{R}{P}\right)^2 = 0.89$, and it would be found that three 1-in. rivets in single row or four 1-in. rivets in double row would be sufficient.

From the preceding discussion it appears that the design of eccentric riveted connections can be facilitated by the use of equations in which the number of rivets required is expressed as a function of the value of the rivet, the load, the pitch, and the eccentricity, in such a way that any pitch may be used for any assumed rivet.

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

Salt-Water Barriers Not Technically Feasible

To the Editor: In connection with Mr. Hyatt's article on "Combating a Saline Invasion in California," in the September issue, I would like to enlarge somewhat upon the hydraulic practicability of a salt-water barrier. In deciding upon the feasibility of engineering works, social, political, and economic considerations are of primary importance if the proposals are technically possible. The salt-water barrier, however, is not technically feasible, for it could not bring about the desired results. In the heat of controversy over its cost and the value of the benefits, the technical problem of whether or not it would work was almost lost sight of.

Barriers at the Charles River basin and the Lake Washington ship canal have permitted a considerable quantity of salt water to pass through into the supposedly fresh-water pool, and at Panama salt has worked its way into Gatun Lake, which is some 80 ft above sea level. These facts were decidedly unfavorable to the possibility of maintaining a fresh-water pool above the salt-water barrier, and the War Department decided to sponsor a series of experiments in cooperation with the University of California. The original objective of these experiments was to discover the model law underlying the phenomenon of the migration of salt water through locks. A large model of the proposed location was then to be built so that the problem could be studied in detail. However, the results of these experiments were so conclusive that no further work was done.

A report on the purely technical features of the work was published by Cherno and O'Brien in the December 1932 issue of the *Transactions* of the American Society of Mechanical Engineers. The phenomenon involved is relatively simple. Suppose, first, that a lock is filled with fresh water and that a ship is to enter from the salt-water side. The water levels are equalized; but when the gates are opened the salt water, being heavier, flows into the lock along the bottom and the entire charge of fresh water flows out along the surface. The lock is then full of salt water to its downstream level. After this fresh water is added to bring the surface to the upstream elevation, thus diluting the salt charge in proportion to the ratio of lift to depth above the sill. When the upstream gates are opened, the charge of salt water flows out along the bottom into the upstream pool. The net result is that for each lockage a volume of fresh water equal to that of the lock between the sills and the upstream level is lost and an almost equal volume of salt water enters the upstream pool.

I have observed this phenomenon at both the Lake Washington ship canal and the Charles River basin. At the latter installation, the surface was watched during the passage of a rowboat and the surface motion of the fresh water through the lock was very apparent.

One question which arose was whether salt water would diffuse upstream through the channels as far as at present after the diffusing action of tidal currents had been partially removed. Not much information is available on diffusion through either still or moving water, but measurements in estuaries do indicate that inflow of salt water along the bottom and outflow of fresh water along the surface are common. A salinity survey of the estuary of the Columbia River showed salt water at the bottom more than ten miles inside the jetties, while nearly fresh water covered the surface several miles seaward of the jetties. In other words, in spite of the mixing action of the tidal currents and flushing by river discharge, salt water was working inward along the bottom. Construction of a barrier would cut off the tidal currents and reduce the maximum outflow of fresh water so that an increase of salinity would result on the seaward side.

Morrough P. O'Brien, Assoc. M. Am. Soc. C.E.
Associate Professor of Mechanical Engineering
University of California

Berkeley, Calif.
September 30, 1935

Characteristics of Soils for Rolled Fills

Dear Sir: In connection with Mr. Lee's article, "Selecting Materials for Rolled-Fill Dams," in the September issue, it is of interest to consider recent research work in this field. Various agencies have brought out factors affecting the characteristics of soils used for construction work such as roads, dams, and foundations. New phenomena hitherto unexplained are being investigated, such as the causes for varying void content of fine materials as affected by surface tension and possible molecular attraction, and adhesive properties of thin water films.

At present practically all earth dams are designed on the theory that there should be a relatively watertight barrier of fine materials supported by materials permitting drainage at such a rate that the hydraulic gradient will fall within the downstream toe.

It is now proposed to design a section of dam that will be stable within itself without support from a pervious downstream section. This idea is based on the conclusions that the supporting power of the soil can be predetermined with varying moisture content, and that the proper use of materials will prevent absorption of a detrimental amount of moisture.

The underlying factor on which the work of Proctor and others is based is the requirement for a confined material. It is still an open question whether or not this condition exists at the water-contact surface of a dam, and whether or not detrimental absorption of moisture can take place in a long period of time, from exterior to interior, permitting the material to swell gradually and absorb more moisture than would be expected according to theory.

The pervious section of a dam can generally be constructed at a lower unit cost than an impervious section, and the drainage provided is an added safeguard at no extra cost, since the impervious section would occupy only the upstream part of the dam.

Samples from rolled-fill and hydraulic-fill dams indicate that a very wide range of materials, having varying degrees of porosity, grading, fineness, and strength, can be used successfully. With dams of more than ordinary width, a much wider range of materials can be used than with dams of very slender cross-section. For dams having a rapid draw-down of the reservoir, much more care must be exercised to prevent sloughing. For certain types of use, leakage is not an important factor so long as the grains of material are not disturbed.

Mr. Lee's application of the Talbot equation pertaining to grading is of especial interest, and reaffirms the principle that maximum density under all conditions can best be obtained by proper range in grading. The compaction results obtained from a vibrating roller may be similarly beneficial as the conclusion drawn from the Talbot analogy.

It was found that the materials used for the puddle core of the El Capitán dam, constructed by the City of San Diego, Calif., produced a practically watertight barrier with a minimum of 30 per cent by weight passing a 200-mesh sieve. On the other hand, when the clay and silt content dropped below 30 per cent a very noticeable increase in percolation resulted.

Furthermore, materials that were only slightly compacted leaked profusely until an equivalent fill weight of about 45 ft had been reached. From this point the rate of percolation decreased progressively until about the 90-ft point, when it dropped off very sharply.

The minimum void content obtained in the puddle core of the El Capitán dam at the time of testing was about 32 per cent under a head equivalent to 75 ft of fill and only slightly below 30 per cent for greater heads.

Much investigation remains to be done before all the factors which affect earth dams become sufficiently known to make final conclusions possible. Mr. Lee's paper is a step towards the formulation of limiting factors.

Paul Beermann, Jun. Am. Soc. C.E.
Civil Engineer, Division of Development and Conservation, Water Department, City of San Diego

San Diego, Calif.
September 27, 1935

Derivation of Beam Formulas

TO THE EDITOR: An understanding of the development of the formulas given elsewhere in this issue by Professor Tsai in "Functions of Beam with Equally Spaced Concentrated Loads" is perhaps desirable for those who intend to make use of the equations.

In Fig. 1 is given the load and moment diagram for a beam holding two symmetrically placed loads. The beam under consideration carries a series of such loads in which a has the successive values of 1, 2, 3, ... r, where r equals $(N-1)/2$ when N is odd and $(N-2)/2$ when N is even. When N is even, an additional load, P, is carried in the center.

For a single pair of loads the moment in the center is

$$M = \frac{PL}{N}\,a \qquad \ldots\ldots[1]$$

As $EI\phi$ equals the area of the left half of the moment curve with changed sign,

$$-EI\phi = \left(\frac{PLa}{N}\right)\left(\frac{La}{N}\right)\frac{1}{2} + \frac{PLa}{N}\left(\frac{L}{2} - \frac{La}{N}\right) = \frac{PL^2}{2N}\left(a - \frac{a^2}{N}\right). \qquad [2]$$

The first moment of this same half of the moment curve about the left support gives the deflection of the left support from the tangent in the center or, numerically, the deflection of the beam at the center, whence:

$$-EI\Delta = \left(\frac{PLa}{N}\right)\left(\frac{L}{2}\right)\left(\frac{L}{4}\right) - \left(\frac{PLa}{N}\right)\left(\frac{La}{N}\right)\left(\frac{1}{2}\right)\left(\frac{La}{3N}\right) = \frac{PL^3}{2N}\left(\frac{a}{4} - \frac{a^3}{3N^2}\right) \qquad \ldots\ldots[3]$$

The sums of the following series can be found in works on algebra:

$$\Sigma\,(1 + 2 + 3 + \ldots r) = \frac{r(r+1)}{2}$$

$$\Sigma\,(1^2 + 2^2 + 3^2 + \ldots r^2) = \frac{r\,(r+1)\,(2r+1)}{6}$$

$$\Sigma\,(1^3 + 2^3 + 3^3 + \ldots r^3) = \left[\frac{r(r+1)}{2}\right]^2$$

In the case when N is odd, substituting $(N-1)/2$ for r in the series obtained from Eq. 1 we get:

$$M = \frac{PL}{N}\sum_o^r a = \frac{PL}{N}\left(\frac{1}{2}\right)\left(\frac{N-1}{2}\right)\left(\frac{N+1}{2}\right) = \frac{N^2-1}{8N}PL \ldots [4]$$

Again from Eq. 2 we get:

$$-EI\phi = \frac{PL^2}{2N}\left[\sum_o^r a - \frac{1}{N}\sum_o^r a^2\right] = \frac{PL^2}{2N}\left[\frac{N^2-1}{8} - \frac{(N-1)(N+1)N}{N \times 6 \times 2 \times 2}\right] = \frac{PL^2\,(N^2-1)}{24\,N} \qquad \ldots\ldots[5]$$

and from Eq. 3 we get:

$$-EI\Delta = \frac{PL^3}{2N}\left[\frac{1}{4}\sum a - \frac{1}{3N^2}\sum a^3\right] = \frac{PL^3}{2N}\left[\frac{N^2-1}{8 \times 4} - \frac{1}{3N^2}\left(\frac{N^2-1}{8}\right)^2\right] = \frac{PL^3(N^2-1)\,(5N^2+1)}{384N^2} \qquad \ldots\ldots[6]$$

The central load with even values of N produces the following values:

$$M = \frac{1}{4}PL, \quad -EI\phi = \frac{PL^2}{16}, \quad -EI\Delta = \frac{1}{48}PL^3 \qquad \ldots\ldots[7]$$

For the formulas when N is even, substitute $(N-2)/2$ for r in Eqs. 1, 2, and 3, then sum as before, and add the corresponding value from Eq. 7.

When the beam is fixed at the ends a moment is induced of such value that the total area of the moment curve is zero. That is, the area of the moment curve due to the end moment M_e or M_eL is equal in value and opposite in sign to that due to the loads. Whence

$$\left(\frac{PLa}{N}\right)\left(\frac{L}{2}\right) - \left(\frac{PLa}{N}\right)\left(\frac{La}{N}\right)\left(\frac{1}{2}\right) + \frac{M_eL}{2} = 0; \quad \frac{PL}{N}\left(a - \frac{a^2}{N}\right) + M_e = 0; \quad M_e = -\frac{PL}{N}\left(a - \frac{a^2}{N}\right)$$

The end moment due to a load P in the center of the fixed beam is $-PL/8$.

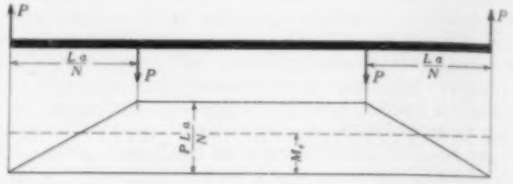

FIG. 1. MOMENT DIAGRAM FOR BEAM WITH ONE PAIR OF CONCENTRATED LOADS

For the value when N is odd as before substitute the value of r in the series formed and we get:

$$-M_e = \frac{PL}{N}\Sigma a - \frac{PL}{N^2}\Sigma a^3 = \frac{PL}{N}\left[\left(\frac{N-1}{2}\right)\left(\frac{N+1}{2}\right)\frac{1}{2} - \left(\frac{N-1}{2}\right)\left(\frac{N+1}{2}\right)N\left(\frac{1}{6N}\right)\right] = \frac{PL(N^2-1)}{12N}$$

When N is even the formulas are:

$$-M_e = PL\left[\frac{(N-2)N}{2 \times 2 \times 2 \times N} - \frac{(N-2)N(N-1)}{6 \times 2 \times 2 \times N^2} + \frac{1}{8}\right] = \frac{PL}{8}\left[N - 2 - \frac{(N-2)(N-1)}{3N} + 1\right] = \frac{N^2-1}{12N}PL$$

The maximum moment at the center for a beam fixed at the end is equal to that due to the loads on a simple beam less that due to the end moments, which gives Professor Tsai's formulas for central moment at once.

The deflection of the fixed span is found by subtracting the moment area of the rectangle formed by M_e and $L/2$ about the left abutment from the deflections already obtained.

J. CHARLES RATHBUN, M. Am. Soc. C.E.
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New York, N.Y.
October 10, 1935

Registration Law Not Applicable to All Land Surveyors in Texas

TO THE EDITOR: In an item entitled, "Thirty-Seven States and Possessions Now Have Registration Laws," which appeared on page 592 of the September issue of CIVIL ENGINEERING, it is stated that Texas has a registration law for land surveyors only.

Actually this law applies only to those making original, or correction surveys on original, surveys for filing in the land office at Austin. Ordinary subdivision and boundary dispute surveys require no such registration. Practically all surveying subject to classification for filing is done by county surveyors, whose qualifications are not determined by law.

ARNOLD B. STAUBACH

Austin, Tex.
September 30, 1935

The Salt Water Barrier

TO THE EDITOR: In his very illuminating article, "Combating a Saline Invasion in California," in the September issue, Mr. Hyatt covers the "salinity problem" so fully that this discussion will be limited to the conclusions of the studies made of the salt water barrier as a physical structure.

The salt water barrier project at its inception presented problems of a most interesting and complicated nature. It was contemplated that the physical structure as originally conceived might perform many functions, the realization of all of which would be more or less dependent upon the successful accomplishment of the three primary objectives which, in order of priority of importance, may be listed as follows:

1. The annual incursion of salt water into the delta area would be eliminated, or at the very least would be subjected to a large degree of control.
2. A low-level reservoir would be created which, because of its location on the extreme lower reaches of the Sacramento River system, would make possible the ultimate conservation of what might be termed the "last drop" of runoff.
3. Provision would be made for almost unrestricted transportation, both rail and vehicular, across this rather wide stream channel, thus greatly facilitating movement of freight and passengers.

Perhaps the most interesting development as a result of both the intensive and extensive studies of this project is the final conclusion that, while a salt water barrier in the form of a physical structure can be constructed, it will not accomplish with certainty any of these three primary objectives.

It would seem that unavoidable leakage around the lock gates, coupled with other conditions of practical operation, would make it impossible to prevent the invasion of salt water, and under certain conditions might even result in a condition worse than that now existing.

The proposed low-level conservation reservoir would have a relatively limited capacity due to the fact, as disclosed by the studies, that under no circumstances would it be practicable for the elevation of the water surface to exceed that of the maximum flood plane. Also, there are serious objections to maintaining the water surface even at such an elevation except for very short periods of time. Under this limitation sufficient storage capacity could not be secured to provide for the operation of the locks. It was developed also that the area of the water surface, particularly the marginal area, where the water would be very shallow, would result in a very large loss by evaporation. In other words, the studies seem to show that such a reservoir would actually result in an annual net loss of water instead of in its conservation.

That the structure might provide for almost unrestricted transportation across this rather wide stream channel was not confirmed by the studies. A low-level crossing would be objectionable because of the frequent traffic interruptions due to operation of the locks, while a higher crossing presented serious problems as to approach and "get-away," and also the possible sites were not the most strategic ones for both rail and vehicular traffic.

Studies carried out by the California State Highway Department and also by the Southern Pacific Company did not result in their enthusiastic endorsement of the project.

The studies also brought out other serious problems, such as sewage disposal and obstruction to navigation, which at the outset did not seem very important. This project, therefore, may be classed as one which originally seemed to provide for the solution of many problems, but which when subjected to a painstaking engineering analysis was found to have little merit.

A. KEMPKEY, M. Am. Soc. C.E.
Consulting Engineer

San Francisco, Calif.
October 7, 1935

Planning—an Economic Necessity

TO THE EDITOR: My article on slum clearance plans for large cities, which appeared in the March 1935 issue of CIVIL ENGINEERING, was apparently misinterpreted by Mr. Herrold, who discussed it in the June issue. In the foreword at the beginning of my article, it is stated that, "although prepared for the situation in New York, the plan developed by the author is applicable to any city having similar conditions." On page 135, I remarked that "for low-rental, slum-clearance projects, buildings should be fireproof and limited in height to four stories, with maximum facilities for light and air." In the city of St. Paul, Minn., the land values are so much lower than they are in cities like New York and Chicago, that four-story buildings need not and should not be constructed.

Mr. Herrold makes a serious mistake when he indicates that "inflated land values and architects' commissions" are comparable, and "are being given too much consideration in solving the problem." Municipal administrations are primarily to be blamed for inflated land values in blighted areas; at least, that is so in New York City. So long as the tax boards permit assessments on old buildings, which are not worth the powder to blow them to pieces, to be assessed for as much as, or for more than, the land, blighted areas will continue to increase (which is the case in New York City). There are political reasons why the various administrations have thus far done everything possible to prevent the scattering of the population now in existing slum areas. Architects or engineers, who design buildings from a primary consideration of commissions, are not worthy of being associated with their professions.

Mr. Herrold is absolutely correct when he states that, "the solution of the slum clearance problem does not lie in building tenements that will produce speculation and upset the tax structure of a district." He is also to be commended for emphasizing the fact that "the problem of rehabilitation of blighted areas in the near bankrupt cities of the United States is the greatest economic problem that has ever confronted them."

I have tried to point out that there is no further necessity for maintaining such high population densities as were created in the past by the cooperation of a certain type of speculative builders, with selfish politicians temporarily in control. As a matter of fact, with only 3 per cent allowed by the federal government for architects' commissions, this factor has very little bearing on the ultimate rental, whether the buildings are two stories or four stories in height.

I am convinced, however, that the problem of rebuilding slum areas is primarily one of economics and political economy, with architecture and engineering of secondary importance. A large Chicago project and others were turned down by Secretary Ickes recently, because of the difficulty of land assembly at reasonable prices. Also, the Williamsburg project of New York City has taken about two years to reach the present stage, namely, land assembly, part of which has been bought and paid for. In connection with the latter project, over three hundred property owners have opposed condemnation proceedings on the grounds that neither the city nor the federal government has the legal right to condemn these properties for low-rental public housing.

I am convinced that if the present unsuccessful policy of slum clearance development were continued, there would be repercussions that would seriously affect municipal credit, as well as the entire real estate structure. The government's intention of getting as many people back to work as soon as possible will not succeed unless some form of partnership between public and private enterprise is made effective in the manner indicated in my article. Merit and not politics must always be the primary consideration. Many now feel that the government's housing plans have failed in principle, because of a lack of the foregoing considerations.

I would like to emphasize the fact that each local blighted area represents a problem that varies in the different cities and that the gradual, but planned, elimination of blighted areas is an economic and social necessity for each municipality, if the increasing burden of taxation on real estate, and the health and the morale of the people are to be considered.

MAURICE DEUTSCH
Architect and Engineer

New York, N.Y.
October 9, 1935

The Relation of Long-Range Planning to Emergency Expenditures

TO THE EDITOR: I have read with interest Mr. Fox's paper on "Planning Emergency Public Works," in the September issue of CIVIL ENGINEERING. Mr. Fox states that the experience of the Federal Emergency Administration of Public Works in expending the original appropriation of $3,300,000,000 for public works construction emphasized the fact that "there was something lacking, something preventing the fulfillment of an intelligent, expeditious, and efficient spending of an unprecedented sum...." He calls this something which was lacking "comprehensive planning" and implies that it is a new science.

I can agree with this statement only in part. The three-billion-dollar PWA appropriation was intelligently and efficiently allotted. Whether the money might have been allotted to projects more beneficial to posterity had the results of competent long-range planning been available can only be determined by the future. But until time renders a decision to the contrary, it is not in accordance with the facts to say that this PWA appropriation was not spent intelligently and efficiently.

Nor is it correct to say that the absence of "comprehensive planning" delayed the work. Three billion dollars is a lot of money, and Congress had directed that this money be used only on projects that were socially desirable and economically sound and that all loans be legally made and reasonably secured. At the time the act was passed there was no precedent by which those charged with the formation of the administrative organization could be guided. To the extent that a comprehensive plan, if any had then existed, would have supplied this deficiency, its absence might be charged with delaying the PWA program. Undoubtedly the present PWA organization which has been built up through two years of experience could accomplish results in less time, if it had the task to do again. But I do not believe the present organization or any other organization could surpass the record already made as to the desirability and economic soundness of the projects selected and the legality and security of the loans made.

Mr. Fox speaks of comprehensive or long-range planning as a new science. Long-range planning is not a science, and until it is possible for man definitely to predict the future it will not become one. It is an art—an art whose technique will vary and must continue to vary as time proceeds and economic conditions change.

It is wise and necessary that action, especially in regard to public works, should be in accord with a predetermined plan. But to make a plan you must have an idea. Before a planner can have an adequate conception of what he wants to do, or where he wants to go—before he can form an idea as to the future—he must, figuratively speaking, take himself onto a high mount, so that he can see ahead, even as the Lord called upon Moses to do in order to behold the promised land. He must put his head among the clouds. And yet when a planner has thus ascertained where he wants to go—when he has seen the promised land—in order to move in that direction he must put his feet upon the ground. There is the rub, as I see it, in the art of long-range planning. Where can you find a man of sufficient stature that he may have his head among the clouds and at the same time his feet upon the ground? The accomplishment calls for a man of superhuman attributes. It is probably not possible of perfect achievement. But that does not mean that all attempts at long-range planning should be abandoned. Rather does it mean that the actual constructors of public works—the men who are supposed to have their feet upon the ground—should realize that from the very nature of their work, they are not in the best position to see into the future, and that, therefore, they should make provision to obtain and heed the advice of other men, more favorably placed to judge of the trend of the times, of the interrelation of one project to another, and of the ultimate benefit of any specific construction.

A. D. WILDER, M. Am. Soc. C.E.
Acting State Director, Federal Emergency Administration of Public Works

San Francisco, Calif.
October 8, 1935

Need for State Planning

TO THE EDITOR: I should like to comment on Mr. Tilton's article on the "Objectives and Methods of State Planning," in the September number of CIVIL ENGINEERING. The proper and orderly development of a state is necessarily a continuing process. The problems involved are at times of such magnitude as to require many years of watchful care in order to effect a solution. Since existing exigencies over-reach the span of succeeding political administrations, an organization which is to attempt any guidance of the growth of society must be a permanent part of the governing agency maintained by society so that it may grow with and become an integral part of the regularly constituted government.

Today government is, generally speaking, a product of piecemeal growth, need being responsible for the creation of various departments. The ramifications of departmental functions reach into every form of human activity and, in many instances, have a direct effect upon our physical environment. It seems self-evident that some method should be devised whereby these various agencies created to fulfill a human need can be brought into harmonious working relationships, so that one department will not clash with or undo the well-intended efforts of another. Actual savings in the cost of public improvements can be made by effecting such a relationship and by the timeliness of such projects. The problems involved in large public projects are often too great for any one department to envisage and solve alone. The facts and data necessary to a proper solution are often to be found only in a thorough canvass of the whole range of a people's activity, and such an analysis is most properly placed in the hands of a continuing governmental agency, established for that purpose with a trained personnel and given the right to make recommendations in accordance with its findings.

A planning board has as one of its main purposes the assembly of data relative to, and the coordination of, major public or semi-public engineering projects, so that such enterprises, when completed, will have their proper place in the general physical development of the state. Such a board should have the earnest support of engineers generally, it being obviously advantageous to know that the detailed design will fill the immediate need and that, in its ultimate capacity, the project will serve in relation to other projects affecting the people's physical environment or providing the facilities so necessary to modern life.

A statement worthy of closer examination is that the planning board lacks authority, that it can only recommend and advise. At first glance this may seem a regrettable state of affairs, yet in some respects it is an asset rather than a disadvantage. This circumstance makes it necessary to formulate reliable fundamental principles and basic policies.

As important as correct principles of engineering design in any great permanent structure is the determination and adoption of the principles and policies which underlie the actual work and recommendations of the state planning board. This is especially important in view of the fact that the board is limited in power and that its recommendations must, therefore, rest on a bedrock of incontrovertible fact, so that they can withstand the criticism and attacks of entrenched interests, of political expediency, or of private speculative aims and ambitions. Since planning has to do with the land upon which society exists, it necessarily follows that intelligent guidance of the growth of society and the promotion of human welfare must deal with the broad uses of the lands which comprise the state. The present generation exerts stewardship of lands for coming generations. Long-continued, wasteful, and ignorant practices can imperil the very existence of the state and its people.

HARRY BERGH
Planning Draftsman, the Los Angeles County Regional Planning Commission

Los Angeles, Calif
October 1, 1935

Engineering Opportunities in Southern California

TO THE EDITOR: In his article, "Engineering Outlook for Southern California," in the September number, Mr. Goudey has covered in a very satisfactory way a comprehensive subject.

Conditions in southern California limit the engineer from at least two standpoints. One is that our record of experience is relatively short; the other is that this record is extremely erratic. From the standpoint of water supply and flood control, engineers are particularly beset with these limitations.

In the nineteenth century there were five floods, occurring in 1825, 1840, 1862, and 1889, which have not been paralleled in magnitude during the present century. Furthermore, during the period from 1893 to 1904, this region experienced a period of drought such as has not been experienced during the past 30 years. Thus it is possible that conclusions drawn from the last three decades would be entirely misleading as to the requirements which must be provided in the fields of flood control or water supply.

The present developed and available water resources, as estimated by the State Division of Water Resources for this general metropolitan area, incorporating the watersheds of the Santa Ana, San Gabriel, and Los Angeles rivers, amount to a continuous flow of approximately 1,350 cu ft per sec. It is expected that, with the completion of the Colorado River Aqueduct, the quantity to be delivered, allowing for losses in transit and evaporation, will be 1,350 cu ft per sec. Thus we have in prospect a duplication of the present water resources.

From the standpoint of population studies, it is significant that in the last three decades before 1930 this area experienced a growth averaging something over 100 per cent for each decade. The estimate used by the Metropolitan Water District for the decade from 1930 to 1940 contemplates an increase in population of approximately 44 per cent. For succeeding decades it estimates an increase of approximately 33, 22, 11, and 8 per cent, the latter being for the decade between 1970 and 1980, and coincides with what a number of agencies have estimated as the increase in population for the United States as a whole fifty years hence.

From the standpoint of sanitation facilities, the conditions in this region are unique in that, lacking live streams, there are practically no opportunities for dilution as a means of sewage disposal for those cities removed an appreciable distance from the coast line. From the standpoint of transportation, it is very pertinent that fully 75 per cent of the population of the city of Los Angeles is resident in single-family dwellings. This is a proportion far in excess of that found in any other city of over 1,000,000 population in the United States and is several times the corresponding figure for cities like New York and Chicago. Thus there is a wide dispersion of population, which offers some handicap to the development of a rapid-transit program.

There is no question but that the next period of activity in this vicinity will see the provision of increased sanitation and disposal facilities for large areas which do not now have adequate facilities, and of additional efficiency for the use of traffic arteries that now exist. There are limited opportunities for an increase in the number of these arteries, but unquestionably the greatest development will have to be made in the direction of improving the efficiency and increasing the capacity of these thoroughfares. The latter improvements can probably be made largely through grade separation.

Thus it seems that the next few decades will offer great opportunities for engineers to improve the conditions resulting from the concentration of population which unquestionably will occur in southern California.

FRANKLIN THOMAS, M. Am. Soc. C.E.
Professor of Civil Engineering
California Institute of Technology

Pasadena, Calif.
September 27, 1935

Comments on Climatic Cycles

TO THE EDITOR: Under the title, "Climatic Cycles in the West," Mr. Bonner presented in your June issue an able and interesting article in which he endeavored to show by comparing the mean yearly sun-spot numbers with yearly rainfall, departures from yearly rainfall, and 3- to 10-year progressive averages of yearly rainfall, that there is no direct relation between sun spots and rainfall. Such a comparison will not determine whether there is any relationship between solar changes and variation in precipitation for the reason that, while the year is an allowable time period in which to represent precipitation, it is not a time cycle with which to measure solar changes.

Therefore to use a year of solar data obscures the actual solar changes, and the mean yearly sun-spot numbers are not applicable. That fact has been recognized by other investigators.

The known periods of change in the solar activity are as follows: The 27.25-day mean period demonstrated by Fernando Sanford, Astronomical Society of the Pacific, August 1935; the 11-month period demonstrated by C. G. Abbot, the Smithsonian Institution *Annals of the Astrophysical Observatory;* and the solar periods having a variation of from 9 to 14 years, which make up an approximate solar cycle of 23 years when the magnetic polarity of sun spots on each hemisphere repeats (*Sun Spots and Weather*, C. G. Abbot, Smithsonian Institution, November 20, 1933).

The rains repeat each year in season in varying volume, but the cycles of solar variation do not correspond with the year or seasons. Therefore, the mean yearly sun-spot numbers should not be used; instead, the actual daily rains should be compared with the actual solar change. Also, in compiling precipitation records for different localities, the climate of each locality, or region, should be considered. No locality should be included which has a wide variation in climate, as, for example, the eastern desert section of California as compared with the western section from ocean to the top of coast range.

It appears that a month in solar activity is a mean of 27.25 days and that a year of solar activity is 12 times 27.25 equals 327 days, or 11 months, as the actual solar variation is a few days each side of 27.25 days. The mean 11.25-year period when magnetic polarity of sun spots shifts from one hemisphere to the other of the sun appears to be composed of 150 times 27.25 days. However, each new solar cycle laps the preceding cycle, and sun spots should be compiled for new and old cycles as well as for the northern and southern hemisphere of the sun. The 23-year period when magnetic polarity of sun spots returns to the same hemisphere of the sun, appears to be 300 times 27.25 days.

For the past several hundred years, the 9- to 14-year solar periods have balanced out approximately each 45 years, indicating a dominant 45- to 46-year period, and such period appears to be the real precipitation cycle for seasonal rains. Therefore, I suggest that precipitation records should be compiled in 27- and 28-day periods to correspond with the actual 27.25 mean periods of the sun. I think the beginning should be at the minimum after the 11-month solar maximum, and the 27.25 periods should be grouped in 11-month periods each instead of 12-month periods to correspond with the year.

On June 26, 1935, I presented a paper at a meeting of the American Meterological Society held in Los Angeles, to show that there have been predominantly rainy periods at Los Angeles since 1878 on 11- and 23-month cycles within each solar cycle and that these periods change sequence at each solar minimum. The 11- and 23-month rains will be found in other localities. Therefore in checking solar data against precipitation it is well to consider the 23-month rains as well as the 11-month rains, and to remember that the sequence will shift at each solar minimum, although as long at spots of the old cycle persist, the old sequence may continue. When the 11- and 23-month periods retrogress into a seasonal dry part of the year, as in the months from June to August inclusive for Los Angeles, the rains will be mist or light showers. This fact is demonstrated by the 11-month rain of September 23, 1934, at Los Angeles and vicinity. This recurred August 26, 1935, as light showers and mist in Los Angeles, but moved east and became a torrential rain in Arizona and New Mexico. While this region has a nominal wet season the downpour referred to caused the partial disintegration of some adobe buildings.

THOMAS O. MCGRATH

Los Angeles, Calif.
September 30, 1935

Comparison of Pre-Cast and Cast-in-Place Concrete Pipe

TO THE EDITOR: Mr. Whitman's article on "Large Concrete Pressure Pipes," in the September issue, gives a clear picture of manufacturing and installing large pre-cast concrete pipe. His notes on working stresses, carrying capacities, and similar features should be of interest to all who in any way are connected with the design, construction, or operation of large concrete pipes.

It should be noted that there are two types of reinforced concrete pipe used for water conveyance—the pre-cast and the cast-in-place, or monolithic, pipe. Pre-cast pipe is generally manufactured in short lengths at the plant, then transported to the job, laid in a trench, bedded, backfilled, and caulked at the joints. The sections may be poured in forms standing on end or spun centrifugally. Monolithic pipe is poured or cast in its final position in the trench, where it remains undisturbed after the forms are stripped. Although the pouring of this pipe is done in relatively short sections, a continuous monolithic structure usually is produced by securing as nearly perfect a bond as possible between the successive pours and by making the longitudinal steel continuous throughout.

Mr. Whitman has correctly pointed out that by pouring the sections of pipe in forms standing on end a uniformly dense and smooth concrete is produced in pre-cast pipe. In monolithic pipe, the inner surface of the lower half usually has water and air pockets. In designing the Colorado River Aqueduct this fact was recognized by allowing a lower value of coefficient of roughness for pre-cast pipe. As there are no tremendous weights to handle and no expensive joints, monolithic construction for light or moderate pressures often has an economic advantage over pre-cast pipe in large sizes.

The pipe line may be subjected longitudinally to bending stresses, usually produced by an uneven settlement of the ground, or to direct compression or tension due to shrinkage, change in temperature, or an unbalanced longitudinal component of weight or water pressure. In monolithic pipe these stresses are resisted by the beam action of the pipe or by the direct stress of the shell, the longitudinal reinforcement taking tension stresses. In pre-cast pipe, longitudinal bending and tension stresses are relieved at the joints, and longitudinal steel is provided only in nominal amount for tying together the hoop reinforcement.

The behavior of the two types of pipe in a plane transverse to the

CONSTRUCTION OF MONOLITHIC CONCRETE SIPHON ON COLORADO RIVER AQUEDUCT

Inner Steel Forms and Elliptical Reinforcement in Place

axis is similar under all types of loading, except for slight differences due to the difference of bedding.

The pipe is usually subjected to two types of loads: The external loads tending to collapse the pipe, which produce bending stresses, and the internal hydrostatic pressure, which produces direct tension. Reinforcement steel against bending should be placed near the inside face at top and bottom of pipe and near the outside face at the sides. Elliptical reinforcement is best suited for this case. Direct tension is best resisted by circular reinforcement.

The stress in a pipe shell is usually a combined bending and tension stress. For low heads the bending stresses are predominant and a single elliptical reinforcement is sufficient. For high heads where direct tension is predominant, circular reinforcement has to be introduced.

D. B. GUMENSKY, Assoc. M. Am. Soc. C.E.
Metropolitan Water District of Southern California

Los Angeles, Calif.
September 27, 1935

Mechanical Analysis of Soils

TO THE EDITOR: I would like to comment on Mr. Lee's article on "Selecting Materials for Rolled-Fill Dams," in the September issue. Any method of design and construction control for rolled-fill earth dams that is based on determining the suitability of soils by mechanical analysis alone may fail, due to the fact that it is purely a laboratory theory and supplies no data for determining the proper placing moisture or the required size, weight, and type of compaction equipment.

We know from past experience that a mechanical analysis will determine very closely what density to expect from a given soil, but in our experience no mechanical analysis has as yet been carried out far enough to give an absolute control over the permeability characteristics of a given soil. According to a theory published by the U. S. Department of Agriculture, the particles that govern plasticity and permeability in a soil are those one micron or smaller in diameter. Our investigations tend to bear out this theory, and until a much greater knowledge of these particles that go to make up the colloidal substance in a soil is gained, the practicability of determining the imperviousness of a soil by this method is limited. Even though a definite trend toward imperviousness is shown by the fact that the soil has grading curves within the grading limits, the results require checking by permeability tests to be on the safe side.

Any method of determining the suitability of soils for rolled-fill earth construction, which attempts to solve the problem from the standpoint of density and permeability, does not give sufficient data for a complete solution. Even though a soil selected by this method gives a high density and a low percolation rate, without a knowledge of its plasticity readings at various moisture contents and its stability at saturation, it is impossible to predict with any degree of accuracy whether or not it would be suitable for a rolled-fill earth dam.

Assuming that the material was selected because it fell within the limits of the grading range, further tests would have to be run to determine the placing moisture, the penetration pressure required for compaction at that moisture, and the stability of the soil thus placed when saturated. All this information can be determined from the compaction and plasticity curves, as explained by Mr. Proctor in a series of articles in the *Engineering News-Record*, as well as the determination of the suitability of the material for use in rolled-fill earth dams. Furthermore, these tests can be performed faster and with less expensive apparatus than that required for a complete mechanical analysis. Much less skill is required in running compaction and plasticity tests than in performing the Bouyoucos test for determining the percentage of fine particles. Also, the mechanical analysis would have to be carried below five microns to be of practical value in the determination of permeability.

In conclusion, the grading curves of a mechanical analysis must be correlated with the plasticity curve as well as with the density void space and permeability before a definite or safe answer can be given as to the suitability of the material for rolled-fill earth construction.

Proctor's tests, closely followed and properly understood, give definite answers that determine not only the suitability of the material but all pertinent information regarding field control and the results to be expected in the finished structure as regards settlement and saturation.

H. A. VAN NORMAN, M. Am. Soc. C.E.
Chief Engineer and General Manager, Department of Water, City of Los Angeles

Los Angeles, Calif.
September 25, 1935

SOCIETY AFFAIRS

Official and Semi-Official

Southern Hospitality at Its Best in Fall Meeting

Birmingham Meeting Marks High Point in Technical and Social Success

WITH THE RESUMPTION of quarterly Society meetings, attention has been directed particularly to the first such gathering to be held since 1932. This tended to put Birmingham, Ala., chosen for this honor, in the difficult position of justifying its selection. The sequel, as it unfolded October 16–19, more than fulfilled the optimistic expectations of local groups and Society officers. Measured by its attendance, its strong engineering program, and its overflowing spirit of good fellowship, the Fall Meeting in Birmingham was outstanding.

THE REGION COLORS THE MEETING

Because it is one of the large centers of population of the Southeast, Birmingham is the natural gathering place of engineers. Commercially it serves a large territory both in Alabama and in the neighboring states of Mississippi and Tennessee. Industrially, it is still more important. Its coal, iron, and steel plants employ large numbers locally and send their products all over the South and abroad on the high seas. Power also is a notable source of business and engineering activity.

As though these features were not enough to ensure a fine technical meeting, still another, closely related to them, added to the interest. The Tennessee Valley improvements are demanding large and important technical staffs and are expected by those in charge to revolutionize the social as well as the economic future of a vast belt nearby. From these valuable sources was drawn much of the engineering interest of the Fall Meeting.

Following the usual formalities of opening the meeting on Wednesday morning, the three separate gatherings—morning, afternoon, and evening—were devoted largely to the frank exposition of a variety of views regarding the development and future of the great Southeast. One group of speakers saw in present developments tendencies toward excessive government control and viewed the future with considerable anxiety, if not alarm. On the other hand the social policies of government, as illustrated by the Tennessee Valley Authority, were just as warmly defended. To the neutral observer, the entire discussion was most enlightening, and visitors were enabled to comprehend much more clearly the interplay of conflicting philosophies.

DIVISION MEETINGS FOUND SATISFYING

Morning and afternoon sessions on Thursday provided opportunity for some excellent engineering programs developed by the Divisions, six separate sessions in all. Notable among these were the double sessions of the Surveying and Mapping Division. An enthusiastic group utilized both morning and afternoon to the limit of time in discussing surveying in its practical application in the Tennessee Valley and in Alabama, Mississippi, and Louisiana.

Another group of two sessions was under the joint direction of the Construction and Highway Divisions. Low-cost roads in Tennessee and elsewhere claimed attention in the morning, while Florida drainage construction on a large scale and concrete construction at Norris Dam held the center of the stage in the afternoon. So great was the interest in the motion pictures of the latter work that an extra showing was required.

Advances in sanitation in the South featured the single session of the Sanitary Engineering Division. Sewage work in Atlanta and Birmingham, and malaria control over a wider territory were amply presented before being discussed at length. Still another Division, the Structural, listened to an interesting group of papers on steel construction. Bridges in Alabama and on the Mississippi received due attention, as well as the application of structural steel to athletic stadiums.

In accordance with past practice, an effort will be made to bring a generous part of all these papers to the attention of every member by means of abstracts in CIVIL ENGINEERING. The entire facilities of the December issue will be devoted to this endeavor.

Without interfering with these splendid meetings, a number of other activities were carried out successfully. The Board and its committees were busily engaged at various times and to good effect, as noted in the minutes, also printed in this issue. The nominating committee met as required by the Constitution.

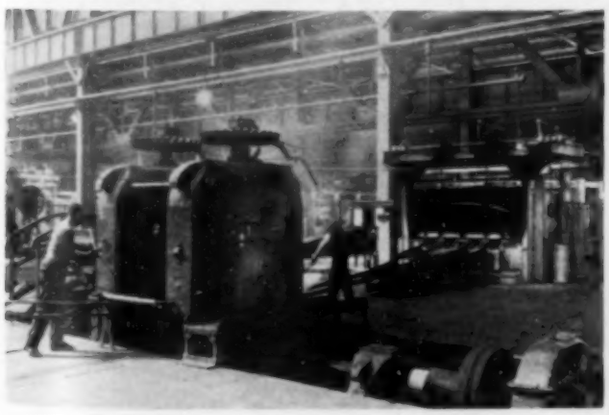
CONFERENCES ARE SUCCESSFUL

Tuesday afternoon was selected for a conference of delegates from the Local Sections in the Southern District. It took the form of a round table discussion featuring such subjects as social activities, participation by Juniors, amount and use of funds, and compulsory membership on state or regional lines.

Again on Thursday another enthusiastic group spent the entire afternoon on matters affecting the Student Chapters. Delegates or delegations were present from most of the southern and even some of the northern colleges. All these, as well as Board and Committee members, entered heartily into the conference.

It would be hard to imagine a meeting in the heart of the South without its due balance of social activities. These started on Tuesday evening, October 15, with a sort of family party arranged by the Birmingham Section. Board members and early arrivals for the meeting met at an informal dinner characterized by good food and enjoyable friendliness.

Somewhat more formal was the dinner and dance the following



FAIRFIELD SHEET AND JOBBING MILL, TENNESSEE COAL, IRON, AND RAILROAD COMPANY

ISHKOODA NO. 13 RED ORE MINE
Tennessee Coal, Iron and Railroad Company

night. The attendance also was greater because of the large number of arrivals for the meeting proper and the wider interest of all members.

SOUTHERN ATMOSPHERE TO THE FULL

All those at the meeting were attracted by the alluring title, "An Evening in the Deep South," announced for the social event on Thursday evening. But few were prepared for what awaited them. The Mountain Brook Country Club needed little to add to its natural beauty and spacious appointments. Beautiful flowers, cosy open fires, and comfortable chairs blended luxury with inviting simplicity.

Passing through the clubhouse to the wide porch and its flanking terraces, the guests beheld an unusual view. At the foot of a wooded slope was an animated scene; at either side and far apart were two huge bonfires with graceful rows of oil torches on tall stakes curving toward the center. Just visible in the foliage behind were representations of growing cotton plants, while filling the center was a stage holding the a capella choir of the Industrial High School, perhaps forty negro singers. In such surroundings the happy plantation songs and the sober negro spirituals took on a more real meaning.

There followed a typical southern dinner with hominy, corn pone, and delicious ham. Half the party used the stately dining room, and others more informally but not less enjoyably filled the grill room. Finally, again in the open, the negro troupe entertained with clog dancing, humorous dialogue, and more music. Now the torches were flickering, but a late moon made up for that loss. An autumn chill made the glow of the fires welcome. Lending atmosphere to all were the grove of stately pines, the sloping lawn with its happy groups, while behind and above was outlined the imposing white facade of the clubhouse.

Still another entertainment, both unusual and instructive, was provided all day Friday through the courtesy and hospitality of the Tennessee Coal, Iron, and Railroad Company. A special train left early to visit steel-making properties ten miles west of the city—first the Ishkooda mine for hermatite ore, then the coke works, wire mill, sheet mill, and steel works, all at Fairfield. Nowhere else perhaps can these processes be seen so conveniently close together. All the works proved highly interesting. For most of the group the wire drawing, wire-fence fabrication, and nail manufacture held a special appeal. Another southern meal invited serious attention. This time it was barbecued chicken cooked over open charcoal fires. The epicures in the party all agreed it was the finest example of that delicacy they had ever tasted.

Some of the visitors stayed over until Saturday in order to see other interesting engineering activities around Birmingham. Several automobiles made the trip to Jordan and Mitchell dams. Inspections of cement mills, of the Shades Valley sewage treatment works and other interesting points were also enjoyed during the meeting.

Aside from these pleasurable and serious features, the generous support of the meeting by local and outside members was a most encouraging development. Between three and four hundred, including ladies, guests, and members of Student Chapters, took advantage of the meeting. For this result the excellence of the technical program should be given major credit. Closely following, or even exceeding it in drawing power were the social features. The result reflects great credit on the small group of hard-working local members who spared neither time nor effort for months beforehand in ensuring the result achieved. To them and their efficient associates of the ladies committee, who arranged teas, drives, and parties in profusion for both men and women visitors, all credit is due. The Birmingham Meeting in its entirety was on a plane that sets an enviable standard for all future fall meetings.

DANIEL W. MEAD FOR SOCIETY PRESIDENT IN 1936

At its Meeting in Birmingham, Ala., on October 15, 1935, the Nominating Committee, following the routine prescribed by the Constitution, unanimously chose Daniel W. Mead, Hon. M. Am. Soc. C.E., as "official nominee" for President of the Society for 1936. His name therefore appears—with the other "official nominees" selected on the ballot canvassed October 15. Voting on these prospective officers will be done in January and ballots will be canvassed just prior to the Annual Meeting.

To a host of his former students at the University of Wisconsin, and to an even larger group of practicing engineers who have known his remarkable engineering success, Professor Mead is much loved and highly respected. In his specialties of power, waterways, and hydraulics, his fame is worldwide. His selection for this important task is therefore a tribute to his character and his eminence.

A brief account of his complete qualifications for this most important office will appear in a later issue.

Society Officers for 1936 Nominated

THE SECOND BALLOT to determine official Society nominees was canvassed on October 15, with the results given on another page. As prescribed in the Constitution, the candidate for the office of president was chosen by the Nominating Committee on October 15, as noted elsewhere in this issue, and the other candidates, Vice-Presidents and Directors, were nominated by ballot. The complete list of official nominees thus determined is as follows:

For President:
Daniel W. Mead, of Madison, Wis.

For Vice-Presidents:
Zone I, Edward P. Lupfer, of Buffalo, N.Y.
Zone IV, Harry W. Dennis, of Los Angeles, Calif.

For Directors:
District 1, Carlton S. Proctor and James K. Finch, of New York (two to be elected)
District 4, C. E. Myers, of Philadelphia, Pa.
District 11, Raymond A. Hill, of San Marino, Calif.
District 14, L. L. Hidinger, of Memphis, Tenn.
District 15, E. P. Arneson, of San Antonio, Tex.

These names will later be voted on by all Corporate Members of the Society in good standing. They will be submitted on the final ballot, to be distributed 40 days before the Annual Meeting and returned before January 8, 1936. On this date the final ballot is canvassed and one week later the officers for the new year are announced, when the tellers make their report at the first morning session of the Annual Meeting. This makes it possible for the president and other officers for the year to be installed immediately. The new Board of Direction generally holds its first meeting the following day.

Meeting of Board of Direction, October 14 and 15, 1935—Secretary's Abstract

ON OCTOBER 14 and 15, 1935, the Board of Direction met at the Thomas Jefferson Hotel in Birmingham, Ala., with President Arthur S. Tuttle in the chair. In addition, Secretary Seabury and the following members of the Board were present: Messrs. Barbour, Burdick, Crawford, Eddy, Etcheverry, Ferebee, Hammond, Hogan, Horner, Leisen, McDonald, Morse, Perry, Reed, Riggs, Sanborn, Sawyer, Sherman, Stabler, Trout, and Wilkerson.

Approval of Minutes

The minutes of the meetings of the Board held on July 1 and 2 were approved.

The minutes of the meeting of the Executive Committee held on October 13 were also approved and the actions outlined therein were adopted as the actions of the Board.

Matters of Professional Conduct

The Board considered and took appropriate action on four matters brought to it by the Committee on Professional Conduct.

National Water Policy Committee

The Board reaffirmed the authorization of a Society Committee on National Water Policy to cooperate with a similar committee of the American Water Works Association, determining the scope and methods of procedure for its committee.

Principles of PWA Procedure

It was reported that, based on the resolution adopted by the Society at the Los Angeles Convention (August CIVIL ENGINEERING, pages 492, 493), the following telegram had been sent to the President under date of September 11, at the time of the conference at Hyde Park, N.Y., to consider, according to the newspapers, the rejection of several thousand PWA projects:

"The Honorable Franklin D. Roosevelt
"Hyde Park, New York

"The wholesale rejection of PWA projects prepared in accordance with the recommended and approved procedures breaks faith with applicants who under previously announced terms have advanced time and money in the preparation of plans for sound and useful projects (stop) Stoppage of proposed worthwhile PWA projects denies opportunity to engineers, architects, skilled workers, and business organizations in the construction industry to continue along lines of their normal training and operations thus throwing more into the ranks of the unemployed (stop) American Society of Civil Engineers strongly endorses the basic principles of PWA procedure (stop) You are urged to correct the injustice of the present situation.

"GEORGE T. SEABURY,

"Secretary, American Society of Civil Engineers"

The Board approved the telegram.

Convention of Engineering Examiners

Upon invitation to be represented at the convention of the National Council of State Boards of Engineering Examiners, to be held at Columbus, Ohio, October 23–25, 1935, Directors Reed and Ferebee were appointed Representative and Alternate, respectively.

Third World Power Conference

Accepting the invitation from the Assistant Secretary of State for the Society to become a member of the American National Committee of the Third World Power Conference which will be held in Washington on September 7–12, 1936, the Board appointed the President of the Society as its representative.

New Members—Division Executive Committees

The following appointments were made to the executive committees of the Technical Divisions, each for a term of five years: City Planning Division, U. N. Arthur; Construction Division, Daniel T. Webster; Engineering-Economics and Finance Division, Frederick H. McDonald; Highway Division, T. Warren Allen; Irrigation Division, Glenn L. Parker; Power Division, B. E. Torpen; Sanitary Engineering Division, Earle L. Waterman; Structural Division, Charles F. Goodrich; Surveying and Mapping Division, Richard K. Hale.

American Engineering Council

As Society representatives to American Engineering Council, Messrs. Eddy, Hammond, Tuttle, Seabury and the incoming President were designated.

Engineers' Council for Professional Development

Approval was given to the incorporation of Engineers' Council for Professional Development.

Invitation to New Board

Following the practice of recent years, it was decided that Society officers to be elected in January next are to be invited to sit with the Board of Direction at the sessions of the outgoing Board at the time of the Annual Meeting in 1936.

Committee on Concrete and Reinforced Concrete Arches

It was recorded that the Committee on Concrete and Reinforced Concrete Arches, consisting of Messrs. Clyde T. Morris, chairman, George E. Beggs, E. H. Harder, A. C. Janni, and W. M. Wilson, had completed the work which it was authorized to undertake in January 1923. Having submitted its final report, issued in the 1935 TRANSACTIONS, the committee was discharged at the suggestion of its chairman. A vote of thanks was tendered by the Board for the valuable work which the committee had done.

Honor to Stephen F. Voorhees

Recognizing the honor accorded to a Society member, Stephen F. Voorhees, in his election as president of the American Institute of Architects earlier in the year, the Board directed that a letter of congratulation be sent to President Voorhees.

New Honorary Members

The Board elected to Honorary Membership the following Members of the Society: John W. Alvord, John F. Coleman, Mortimer E. Cooley, and William J. Wilgus.

Student Chapter at Brown University

Application for the formation of a Student Chapter at Brown University was approved.

Spring Meeting in 1936 at Hot Springs, Ark.

The Board decided to hold a meeting in the spring of 1936 and accepted the invitation of the Mid-South Section to hold this meeting at Hot Springs, Ark.

Civil Service Procedures

The Board reaffirmed the Society's concern with respect to the general disregard of Civil Service regulations and approved efforts to secure the general acceptance of the value of the merit system with relation to engineers and technical employees. This matter, adopted first at the January meeting of the Board, has been a subject for survey by the Field Secretary and the recommendations of the Committee on Aims and Activities. The Board reiterated its intention to endeavor to improve the condition now obtaining and outlined certain administrative procedures in connection therewith.

Membership Committee

The Board took action on 70 cases of membership admission and transfer, as reported to it by the Committee on Membership Qualifications.

Miscellaneous Matters

Other administrative matters were discussed and acted upon.

Adjournment

The Board adjourned to meet at New York, N.Y., on January 13, 1936.

Meeting of Executive Committee—Secretary's Abstract

ON OCTOBER 13, 1935, the Executive Committee met at the Thomas Jefferson Hotel, Birmingham. Ala. Those present were President Tuttle, Secretary Seabury, Past-Presidents Eddy and Hammond, and Vice-Presidents Hogan and Sawyer.

Approval of Minutes

The minutes of the meetings of the Executive Committee held on June 30, 1935, and July 1, 1935, were approved.

Library Budget

The Committee approved the budget for the Engineering Societies' Library for the year October 1935–October 1936.

Administrative Matters

Several financial and other administrative matters were reviewed, on which subjects the Committee took definite action or made recommendation to the Board of Direction, the latter subsequently approving the actions of the Committee as the actions of the Board.

What Changes in Membership Grades Are Desirable?

By HENRY J. SHERMAN, M. AM. SOC. C.E.
CHAIRMAN, COMMITTEE ON PUBLICATIONS; CONSULTING ENGINEER, CAMDEN, N.J.

THE RECENT CONSTITUTIONAL amendment proposing changes in the Society's membership grades has failed; it did not receive the requisite two-thirds favorable vote. A considerable majority of the votes, however, were in favor of the proposed changes, the ratio being 59 to 41. The proposal, it therefore appears, has certain merits of which there is definite approval.

The constitution provides a detailed method of procedure for its amendment and prescribes specific intervals for consideration. While that procedure was of necessity being followed, CIVIL ENGINEERING did not open its pages to comment from the membership. The Society in convention in July at Los Angeles authorized the appointment of two committees, one to prepare a statement in opposition to the amendment, and the other a statement in its support.

Thus provision was made for a balanced presentation of the merits and demerits of the amendment. Requests from two members, that they might express their individual views through the medium of CIVIL ENGINEERING, were denied, that this balance might be maintained. Comment has been offered to the effect that there has not been enough time for proper study and discussion. This probably is quite true. If 59 out of 100 voting members express general approval, the opportunity should now be provided to determine wherein the other 41 per cent looked upon the proposal with disfavor.

CIVIL ENGINEERING, in its department "Our Readers Say," will therefore be opened now to as free criticism as the membership desires to make. Such criticism, however, should be constructive.

HENRY J. SHERMAN
Chairman, Committee on Publications

The proposed amendment contained five fundamental elements, each with some incidental features. Let the discussion therefore take the form of positive basic commentaries on the value of these five elements and their related details:

1. Shall the term "Associate Member" be changed to "Member"?
2. What designation shall be assigned to the higher corporate grade?
3. How shall the transfer of these terms be effected with respect to the present members?
4. How shall new members attain these designations?
5. Shall the Society have student members and on what basis?

Be it noted that to be most effective the desired views will be qualitative. It is not proposed to make this an additional poll but simply to find out what changes in membership designation may be deemed essential and why. To just as great a degree as practicable, and as promptly as possible, CIVIL ENGINEERING will print the constructive comments that the membership may wish to proffer.

Philadelphia Section Protests Dismissal of Engineers in State Service

LOCAL Sections are taking increasingly greater interest in public affairs, and are wielding the influence which their professional standing affords to defend the position of engineers in public employ who are without the protection of civil service. As an example the Board of Direction of the Philadelphia Section has recently addressed a letter on this subject to Governor Earle of Pennsylvania, signed by the following Section officers: President Charles S. Shaughnessy; Secretary-Treasurer Charles A. Howland; Past-Presidents C. E. Myers, Sanford W. Sawin, and I. S. Walker; Vice-Presidents William H. Chorlton and B. F. Hastings; Directors W. E. A. Doherty, Scott B. Lilly, Benjamin A. Sleeper, P. H. Carlin. The letter speaks for itself:

Hon. George H. Earle, 3rd, *October 17, 1935*
Governor of Pennsylvania,
Harrisburg, Pa.

Dear Sir:

The Board of Direction of the Philadelphia Section, American Society of Civil Engineers, wishes to direct your attention to recent dismissals from the State service which are not in accord with your policy or intent as we understand them. Those dismissed are competent, technical men who have been long in the State's service. We fully agree with your policy as expressed in public addresses that no competent employee would be dismissed.

The attention of our Board has been called to many cases of engineers who were suddenly discharged after they have devoted many years to the faithful performance of their duties. A large majority of our membership of 458 engineers reside in the eastern half of Pennsylvania and we cannot but be aware of such a situation. Time and time again we have been urged to protest to you about these dismissals but our Board has not wished to question or criticize changes which you deem proper and presumed to be for the public good. However, the dismissals have increased in number and are of such a nature as to impair efficient service rendered by experienced and thoroughly trained employees.

As an example, we have chosen a particular case from a number and assure you that this citation was not instigated by the employee to whom it refers. On September 28th last, with no advance warning, Mr. Harry L. Kinsel, 518 Fifth Avenue, Altoona, Pa., was dismissed from the service of the State Department of Health. Mr. Kinsel is a graduate of Pennsylvania State College, Class of 1928, with a degree in Sanitary Engineering. While at this institution, he was a member of Tau Beta Pi, Chi Epsilon, and Pi Delta Epsilon, all honorary societies. In addition to being a member of our Society, he is a member of the American Water Works Association, the Pennsylvania Sewage Works Association, and the Pennsylvania Water Works Operators Association. He has contributed to the general advancement of engineering, especially in the sanitary field, by papers and addresses.

Since 1928, with the exception of five months, he has been continuously employed by the State Department of Health, and since 1931 has been the principal assistant engineer, directly under the District Engineer, in District H which comprises the counties of Philadelphia, Bucks, Montgomery, Chester, and Delaware. The records of the Department of Health show that he has displayed excellent engineering judgment, tact, and skill in the performance of his duties which, among a number of other matters, have included the important work of examining plans for public water supplies, sewers, and sewage treatment works, reporting on their engineering soundness and adequacy in connection with applications for the issuance of permits under the laws of the Commonwealth.

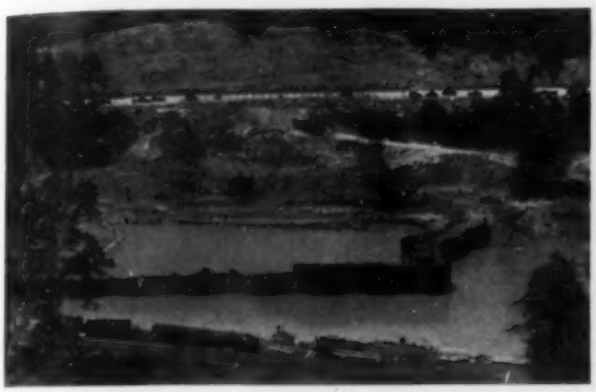
The Board of Direction of our Section asks that Your Excellency have an investigation made of the situation that we describe and, if the facts are as we have stated them, we strongly urge prompt action to secure the integrity of the State services and assure fair treatment to those who have competently and faithfully discharged their duties.

Board of Direction, Philadelphia Section,
American Society of Civil Engineers

Zanesville Regional Meeting Features Muskingum Flood Control

Ohio Engineers Act as Hosts to Local Sections Within Two-Hundred-Mile Radius

ABOUT 50 miles east of Columbus lies Zanesville, Ohio, a city of 36,000 population, situated at the confluence of the Muskingum and Licking rivers and some 60 miles above the entrance of the Muskingum into the Ohio River at Marietta. It is at Zanesville that the famous Y-bridge, a covered wooden structure, existed until 1910, when it was replaced with a more modern concrete structure which perpetuated the Y-plan of its predecessor. A description of the covered bridge and a statement of its relation to the historical survey line, Zane's Trace, together with photo-



FILLING COFFERDAM FOR CONSTRUCTION OF DOVER DAM

CHARLES MILL DAM UNDER CONSTRUCTION

graphs, appeared in the September 1934 issue of CIVIL ENGINEERING, page 502.

Above Zanesville, the drainage area of the Muskingum and its main tributaries, the Walholding and the Tuscarawus rivers, includes over 6,000 sq miles. The cities of Akron, Canton, Massilon, Wooster, Ashland, and Mansfield lie in the upper or northern part of the drainage basin.

Floods from the area have done very considerable damage to towns, railroads, highways, and other property. For 23 years Zanesville citizens studied means of controlling these floods only to find their most conservative plans beyond their financial means. The Muskingum Watershed Conservancy District was formed and the cooperation of the government, the state, and the other communities on the watershed was obtained. It has resulted in funds being made available, through the War Department, for the construction of the necessary dams and reservoirs, and through the state of Ohio, for highway relocation, including rights of way. The District has assumed the cost of lands and the maintenance of the completed works. The Corps of Engineers, U.S.A., was placed in charge of the work to prepare plans, award contracts, and supervise construction.

Plans were begun in February 1934, and in November of that year the first construction contract was awarded. Now all 14 dams are under contract, and rapid progress is being made on their construction. At the peak of the office work, 400 engineers and designers were employed. Besides the work on the dams, many miles of railroad, highway, and utility lines are being relocated above the flood levels in the control reservoirs. The total estimated cost of the work is about $34,500,000, of which about $5,000,000 will be required for highway relocation, $6,000,000 for railroad reconstruction, and $2,000,000 for public utility relocation.

MEMBERS AND STUDENTS JOIN IN INSPECTION

On October 4 and 5 this project, then in the most interesting stages of its construction, was the subject of a regional meeting in Zanesville, attended by members of the Indiana Section, the Pittsburgh Section, and the five Local Sections of the Society in Ohio. Sponsored by the Cleveland Section, these groups were hosts to the following Student Chapters: Antioch College, University of Akron, Carnegie Institute of Technology, Case School of Applied Science, University of Cincinnati, University of Dayton, Ohio Northern University, Ohio State University, University of Pittsburgh, Purdue University, and Rose Polytechnic Institute. A total registration of 315 was recorded, of which number 50 were members of Student Chapters.

On Friday morning and afternoon, members of the engineering staffs of the Conservancy District and the U. S. Engineer Office described the history of the project; the governing hydraulic design data; the general layout of the works; the design of the 14 impounding dams, all but one of which are of earth-fill construction; the methods of relocating the railroads, highways, and public utilities; and the studies being made in the soil mechanics laboratory to control the embankment designs.

Friday evening a stag dinner was arranged at the Rogge Hotel in Zanesville, which was attended by more than 200 enthusiastic members, students, and guests. Director H. S. Morse presided as toastmaster at the dinner, and brief talks were given by Capt. A. C. Lieber, Jr., Corps of Engineers, District Engineer, and by Secretary Seabury. A humorous talk by Dusty Miller closed the evening and put every one in good spirits.

Inspection trips to various dams under construction occupied all of Saturday, October 5. Because of the extent of the project and the distance between dam sites, only three, or at most four, dams could be inspected during the day. Individual groups therefore selected a feasible itinerary, and on arrival at each dam visited the resident engineer in charge, who conducted them over the work. This closed a two-day regional meeting replete with new and interesting engineering developments, which proved worth while for students and members alike.

Arrangements were made by a committee headed by James H. Herron, President of the Cleveland Section; and the facilities of the Conservancy District were made available through the efforts of T. T. Knappen, Chief, Engineering Division, U. S. Engineer Office. For the benefit of members of the Society who were unable to join the group at Zanesville, it is planned to devote considerable space in a forthcoming issue of CIVIL ENGINEERING to the work being done to control the Muskingum River floods. The proposed articles will be based on the papers presented at this regional meeting.

Vote on Constitutional Amendments

ALMOST FOUR THOUSAND CORPORATE members took the opportunity to vote on two amendments to the Society's Constitution. As a result, changes in membership grades were not adopted; but one detail of Society machinery was made somewhat easier. "Proposal No. 1" had to do with such matters as designations of membership grades, qualifications required, and methods of election. "Proposal No. 2" had to do with simplifying the an-

nouncement of "Official Nominees." Details of the amendments and statements for and against Proposal No. 1 were sent to members individually and printed in CIVIL ENGINEERING.

Tellers appointed to canvass the ballots on October 16 at Birmingham, Ala., reported as follows:

October 16, 1935

To the Secretary

American Society of Civil Engineers:

The tellers appointed to canvass the ballot on amendments to the Constitution report as follows:

Total number of ballots received		3,916
Excluded ballots:		
Without signature	8	
With illegible signature	1	
From members deceased since voting	1	
From non-members	5	
Total ballots not canvassed		15
Total ballots canvassed		3,901

Proposal No. 1

Yes	2,311	
No	1,582	
Blank	7	
Void	1	
Total		3,901
Total votes counted on Proposal No. 1 (Yes or No)		3,893
Required to carry		2,595
Lost by		284

Proposal No. 2

Yes	3,220
No	587
Blank	93
Void	1
Total	3,901
Total votes counted on Proposal No. 2 (Yes or No)	3,807
Required to carry	2,538
Carried by	682

Respectfully submitted,

J. W. COTLIN, *Chairman*

J. H. Glander	John A. C. Callan
Robert D. Jordan	W. G. McConnell
Lester Long	John R. Pill
A. R. Brown	C. W. Cooper

Tellers

The Constitution itself requires that, to be effective, any changes in it must be endorsed by a two-thirds majority of those voting. Majority opinion was favorable to the membership changes but failed of the necessary two-thirds vote. This amendment was therefore lost. The second amendment was clearly approved; it makes it possible for members to be formally advised of the official nominees for officers through any Society publication within 30 days after October 15 of each year. This list is therefore printed in the present issue of CIVIL ENGINEERING and not in the November PROCEEDINGS as formerly.

Report of Tellers on Second Ballot for Official Nominees

October 15, 1935

To the Secretary

American Society of Civil Engineers:

The tellers appointed to canvass the Second Ballot for Official Nominees report as follows:

Total number of ballots received . 2,351

Excluded ballots:		
From members in arrears of dues	135	
Not signed	12	
With printed signature	1	
With illegible signature	2	
From non-members	6	
Total withheld from canvass		156
Ballots canvassed		2,195

For Vice-President, Zone I

Edward P. Lupfer	901
Void	0
Blank	100
Total	1,001

For Vice-President, Zone IV

Harry W. Dennis	673
Void	3
Blank	57
Total	733

For Directors, District 1 (two to be elected)

Carlton S. Proctor	587
James K. Finch	534
L. S. Stiles	287
Void	4
Blank	60
Total votes registered	1,472
Total ballots received in District 1 (one-half of above figure)	736

For Director, District 4

Clarence E. Myers	183
Charles Haydock	154
Void	1
Blank	1
Total	339

For Director, District 11

Raymond A. Hill	205
Void	10
Blank	29
Total	244

For Director, District 14

L. L. Hidinger	103
C. E. Boesch	17
Void	1
Blank	1
Total	122

For Director, District 15

E. P. Arneson	111
Oscar H. Koch	98
Edward S. Bres	45
Void	1
Blank	1
Total	256

Respectfully submitted,

G. M. RAPP, *Chairman*

Charles D. Thomas	Jacob Feld
Theo. Barbato	James A. Darling
Benjamin A. Hodgdon	N. S. Covert
Wellington Donaldson	James Wilmot

Tellers

In This Issue . . .

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Zanesville Regional Meeting Features Flood Control ..... *p. 715*
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Preparing Illustrations for Society Publications ..... *p. 717*

Preparation of Illustrations for Reproduction in Society Publications

Requirements in Photographs and Line Drawings for Best Results on the Printed Page

For many years the Society has made it a policy to illustrate its publications as attractively and thoroughly as possible, not forgetting the utilitarian and economic factors involved. To further this end and to enable authors to cooperate fully in maintaining this policy, a review of the details involved in properly preparing illustrations for publication is here given. It is hoped that this review will answer in detail the many questions which arise when an author is preparing a paper for publication. Reprint copies of this article may be obtained from Society headquarters.

TWO kinds of illustrations are used in Society publications and are distinguished by the type of engraved plate required for printing. One type, the halftones, includes all photographs, paintings, wash drawings, or renderings which contain variation or gradation of color. The other type, the zinc etchings or line plates, includes all drawings having a clear white background and sharp, clear lines and lettering. It is the purpose of this article to familiarize contributors with the problems involved in making good reproductions so as to enable them to submit suitable copy.

HALFTONES IN "PROCEEDINGS"

In PROCEEDINGS, photographs are considered exhibits demonstrating a definite idea or principle and are used solely as such. They are therefore given a figure number and become as much a part of the paper as the diagrams or the text. It is necessary then for an author of a PROCEEDINGS paper or discussion to pick his halftone material with this thought in mind. The question arises as to what type of photograph is the best for reproduction in PROCEEDINGS. In general a glossy photograph with good contrast between the high lights and the "darks," and ranging in size within reasonable limits—around 7 by 10 in.—is ideal for this purpose. An approximation of the printed results of a PROCEEDINGS halftone can be had by half closing the eyes and viewing the subject through the eyelashes. This method of course is subject to limitations but it will sometimes help an author decide for himself the feasibility of using a certain photograph solely for information.

HALFTONES IN "CIVIL ENGINEERING"

Photographs for CIVIL ENGINEERING are used most frequently to "dress up" an article. While they may be included for much the same purpose as the halftone illustrations in PROCEEDINGS, for their technical value only, they are not given figure numbers and are not primarily informative in the objective sense of the word. They may be used for their photographic perfection or artistic merit, granted that they are associated with the subject of the article.

For the best results in reproduction, glossy photographs are required. Although very small and very large photographs can be used, here again it is suggested that a 7 by 10-in. size print is the most desirable.

A good grade of paper has been adopted for CIVIL ENGINEERING, enabling the printed results of the halftone to approximate the quality of the original. The fine screen used, 133 lines to the inch, facilitates reproduction of the details of the photography. Halftone reproductions cannot be expected to be as sharp and "contrasty" as the original photographs, since the screen "breaks up" the subject into thousands of small dots. However, by re-etching the high lights and burnishing the darks, contrast can be worked into a halftone plate. This requires extra work on the part of the engraver and is costly.

RETOUCHING OF PHOTOGRAPHS

The accompanying halftones will serve to illustrate the results that can be obtained by special treatment of a photograph and by careful engraving. The halftone reproduction at the left was made directly from the copy submitted, with no special treatment. The halftone at the right was made from a retouched enlargement of the original photograph. The subject has been "straightened up," and the photograph has been "cropped" so as to play up the subject of the story. It may be interesting to note that in many cases the horizon, or the true horizontal line, in a photographic subject is not parallel to the top and bottom of the print. The author need not be concerned with this as the engraver is given special instructions to "straighten" such copy with the "crop marks" which are indicated.

Although rephotographing, airbrushing, splicing, and retouching in general are all available when a subject is important enough to warrant them, an author can facilitate the publication of his paper by submitting the best photographs obtainable. It will be apparent after careful study of the two halftones shown here that considerable attention is given to the artistic merit and mechanical perfection of a halftone reproduction, and that important photographs should not be arbitrarily discarded because of minor imperfections.

PROPER HANDLING OF PHOTOGRAPHS

There are some "don'ts" in the preparation of photographic copy, however, which the author should observe carefully:

1. Do not type or write heavily on the back of the print; inevitably it injures the glossy front surface. Instead, do the typing on a slip of paper and glue the slip to the back of the photograph.
2. Do not use paper clips on the edges of prints. If a clip is needed, use a copy guard of heavy paper under the clip to protect the surface from scratches and indentations.
3. Do not write directly on the face of the print. If necessary to label parts of the photograph, merely indicate them on an

HALFTONE REPRODUCTION MADE DIRECTLY FROM COPY SUBMITTED

REPRODUCTION FROM SAME COPY AFTER RETOUCHING AND SPECIAL TREATMENT

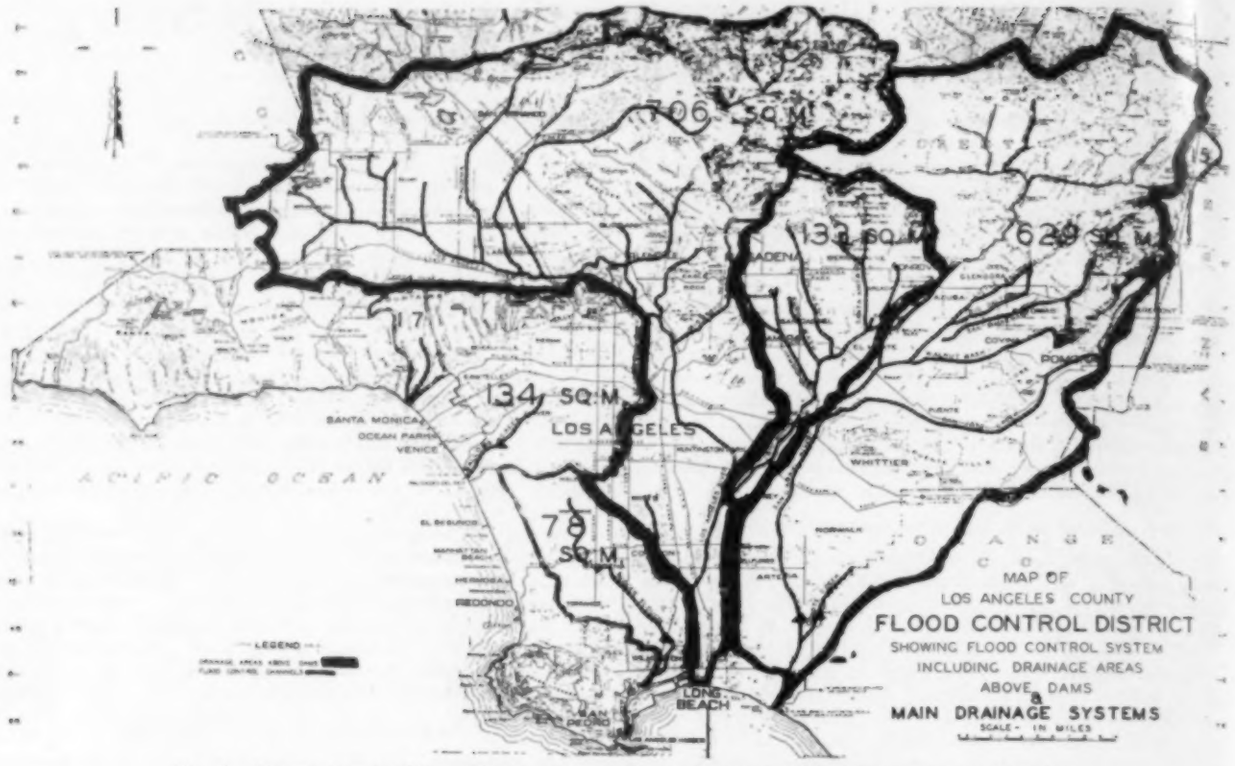


FIG. 1. REPRODUCTION MADE DIRECTLY FROM LARGE DETAILED MAP SUBMITTED BY AUTHOR
This Is Reproduced in Contrast with Fig. 3 to Show the Results of Special Treatment of Line Drawings for Uniformity and Clarity as Explained in the Text

attached slip or paper overlay. These labels will be put on the print, in type, by the Society. In any case avoid marking the face of the photograph with fountain-pen ink. This ink cannot be erased without damaging the print and it cannot be touched out with opaque paint.

4. Do not fold or crease copy for sending through the mail. Send it flat, and well protected by heavy cardboard.

LINE CUTS IN "PROCEEDINGS" AND "CIVIL ENGINEERING"

Drawings submitted for publication in PROCEEDINGS and CIVIL ENGINEERING should be specially prepared. It is not the Society's objective to give complete working drawings in its publications but merely enough information and detail to support the particular point discussed. Thus it can be seen that large shop or field drawings should be considerably simplified before being submitted for publication. Likewise large maps showing an area in minute detail should be simplified. An example of the results that would have been obtained if the author's copy had been used directly is shown in Fig. 1. Compare this with Fig. 3, the same drawing after being simplified and after receiving special treatment for good reproduction. In this case it was necessary to ask the author to trace the essential details from a photostat of his original print. To help the author visualize the amount of detail that could be included in the area allotted for this figure, and to facilitate the subsequent steps of preparing the drawing for reproduction, the photostat was made just twice the size of the proposed line cut. If an author will follow the steps outlined here when he is confronted with large detailed prints, it will help him to determine the amount of material that can be accommodated in the definite space available. The task is a simpler one if original drawings are being made for the express purpose of use in Society publications. It is merely necessary for the author to visualize the dimensions the figure is to assume in printed form and to make his drawing double this scale.

SIZES FOR "PROCEEDINGS" LINE CUTS

The space available for line drawings and the various limitations in PROCEEDINGS are as follows:

Full page (turned sidewise), $7^1/_4$ in. by $4^1/_4$ in.
Full page (upright), $4^1/_2$ in. by 7 in.
Page width (less than a page in height), $4^1/_2$ in. by 5 in. (or less).

No folding inserts have been used in PROCEEDINGS for ten or more years because of their prohibitive cost.

SIZES FOR "CIVIL ENGINEERING" LINE CUTS

In CIVIL ENGINEERING the line drawings should be made to accommodate the following sizes:

Full page (maximum size), 7 by 10 in.
Less than full page, $5^3/_8$ in. (or less) by $9^5/_8$ in. (or less)
Column width, $3^3/_8$ in. by $9^5/_8$ in. (or less)

It is possible to divide a wide figure into two parts across facing pages to secure a length of 15 in. This expedient is adopted only when a drawing cannot be condensed; it should be avoided if possible.

PREPARATION OF DRAWINGS BY DRAFTSMEN

Many members have asked about the actual details of preparing a drawing for publication by the Society. The Society does not have its own draftsmen because of the varying quantity of the work. At times it is necessary to put 20 or more men on good-sized jobs which must be finished in a very limited period of time. Then again there are times when there is not enough work to keep one man busy. Many years of experience have proved that the

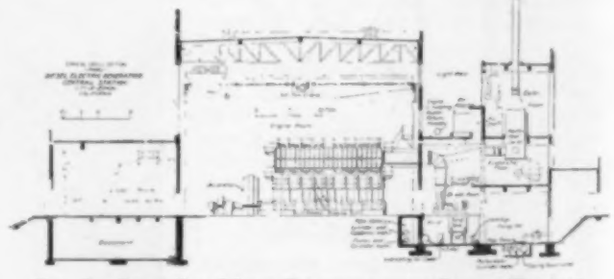


FIG. 2. LINE CUT MADE DIRECTLY FROM LARGE TRACING SUBMITTED BY AUTHOR
Compare These Results with Those Obtained in Fig. 4

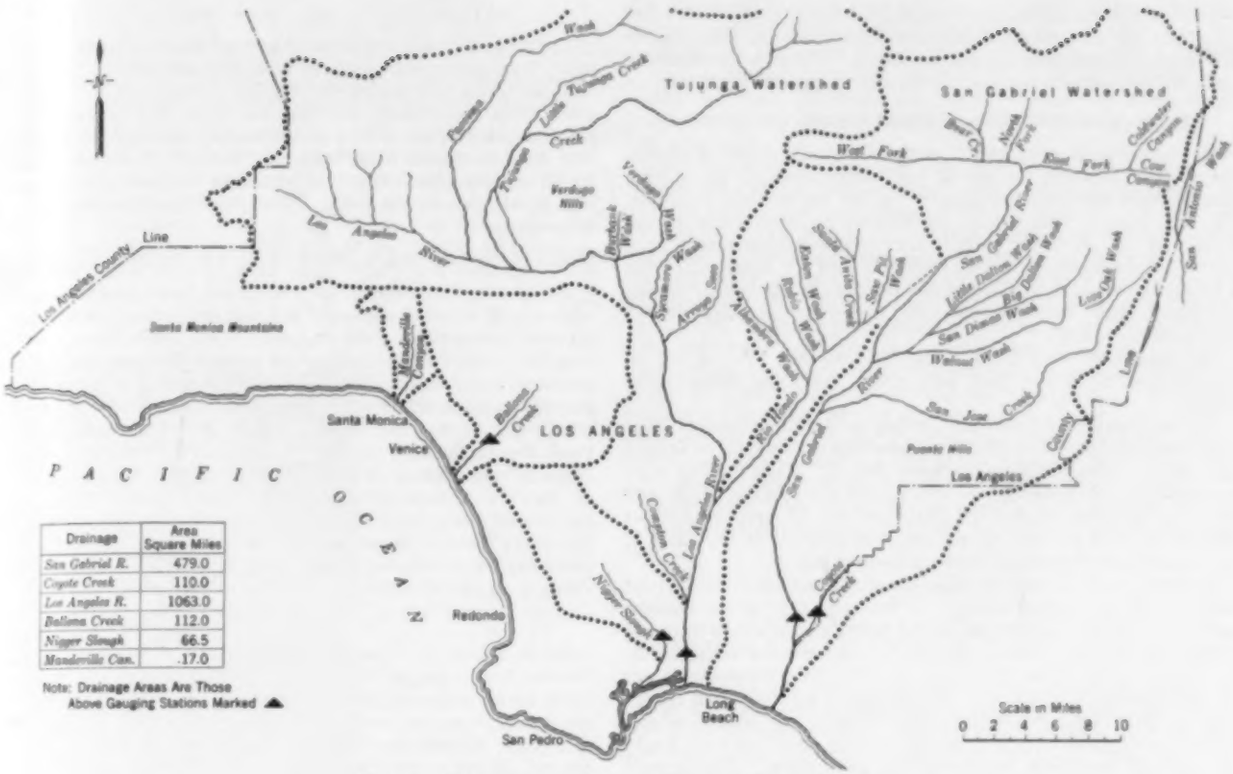


FIG. 3. SAME AS FIG. 1 AFTER SPECIAL TREATMENT

The Author Cooperated to the Extent of Tracing and Labeling the Pertinent Data, Thus Enabling the Editors to Simplify the Drawing

best work and the most reasonable prices can be obtained through competitive bidding by a number of drafting companies.

WAX ENGRAVING PROCESS

Until a few years ago the Society had much of its work done by a process called wax engraving. This method had some advantages but its many disadvantages, as will be explained, have caused it to be dropped in favor of the present practice of photo-engraving. The wax-engraving process is virtually that of making the line work with a stylus and imprinting the type in a thin coat of wax which has been spread evenly on a smooth copper plate, and then electroplating the waxed plate with copper. The wax or matrix is necessarily destroyed in the process, so that if corrections in the line work are necessary after the electroplate has been made, the parts in error must be remade and pieced in. In the case of an error in the type material, the block would be mortised, removing the type in error, and the new characters would be inserted directly into the block. This costly method of making corrections, the cumbersome job of checking the wax plates and noting the corrections on the wax itself, and the fact that the original is destroyed in the electroplating process, combined with the high first cost of the plates due to the less competitive nature of the work, have influenced the Society in choosing the photo-engraving reproduction process in making its line work.

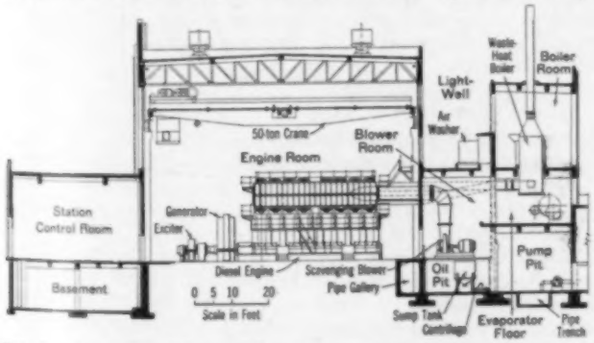


FIG. 4. LINE CUT MADE FROM A TYPE-STAMPED PHOTOGRAPH OF THE ORIGINAL TRACING

Parts Not Wanted Were Blocked Out and a Few Light Lines Were Retouched

LINE WORK FOR PHOTO-ENGRAVING PROCESS

The photo-engraving process of reproducing line work has several advantages over wax engraving, the most important of which is that the author's original line work can be used if properly prepared. The author's drawing is photographed and the hand lettering and parts not to be reproduced are blocked out on the photographic negative. The line work on the positive print is retouched where necessary and the type is stamped directly on the print. If the author's original line work is simple, and if the lines are sharp, the same procedure may be followed using photostats in place of photographs.

To demonstrate the results that would be obtained in many cases if the author's tracing were reproduced directly, a cut was made from the copy submitted. This is shown as Fig. 2. By photographing, blocking out the original lettering, touching up a few light lines, and type-stamping, the results shown as Fig. 4 were obtained. The author's original line work was used in both Fig. 2 and Fig. 4.

USE OF TYPE-IMPRINTED PASTE SLIPS

It has been found that this method—photographing the line work, blocking out the lettering, and then type-stamping—is more satisfactory and less costly than that of pasting type-imprinted slips directly on the author's tracings or drawings. Paste slips have the disadvantages of slightly damaging the original drawings and of falling off in handling. Furthermore, it was found less convenient to hold such drawings after their use in PROCEEDINGS until they could be corrected if necessary for TRANSACTIONS many months later. These disadvantages, combined with the general unsatisfactory nature of such handling, have influenced the Society to use pasted lettering slips only in isolated cases.

GENERAL PROCEDURE IN PREPARATION OF DRAWINGS

In the past, over 50 per cent of the diagrams, charts, and maps submitted for publication have required redrawing. For the

purpose of explanation, take a typical job consisting of 25 drawings submitted for illustrating a paper in PROCEEDINGS, and assume that good line drawings are not available. A competent drafting company will be awarded the job through competitive bidding.

PHOTOSTATING TRACING, TYPE-STAMPING, AND INKING

The first step in preparation of the drawings is that of photostating them to twice the size of the finished cut, the size having been marked on the original drawing by the author or editor. The line work is then traced by making an impression on the surface of the photostat with a hard pencil or stylus so that a special carbon (light and easily removed from the drawing) offsets onto the drawing paper. Then the lettering is applied by means of a hand clamp, which imprints one line of type, or one symbol, with each operation.

The type-imprinting being completed, the line work is put on the drawing, using the light lines traced from the photostat as guides.

The foregoing operations are carried on simultaneously so that duplicate lines of type or typed symbols may be stamped on several drawings with one set-up in the hand ciamp. When the line work is completed, the drawings are cleaned with art gum and touched up where necessary with white opaque paint. Transparent paper covers, or overlays, are put on the drawings for protection and for the purpose of marking corrections or changes.

The type used on society drawings is a standard printer's type and is known as "News Gothic." A ten-point type on the drawing gives a five-point reproduction in the book, and has been found to be the best minimum size for legibility. Larger sizes are available for display or important information. The News Gothic—known for its simplicity and clarity—was chosen as a style which closely approximates that of good engineering lettering. It has the definite advantage of uniformity over hand-lettering, as it has been found that no two engineers use exactly the same style. Then too, it would be impossible to reduce drawings to the exacting sizes of a publication such as PROCEEDINGS and expect to get any uniformity in size.

These considerations make it inadvisable for authors to go to the trouble of carefully lettering their drawings for reproduction. The possibility of using, say, one or two good hand-letterers to do all the Society's work has been studied but has been found impractical because of the volume of the work and the speed and precision required. It is also found that type-imprinting, with all its advantages of uniformity, readability, and general mechanical perfection, combined with the speed with which it can be executed, is not excessive in cost and compares favorably with the less satisfactory method of hand-lettering.

BLEACHING

Drawings that are too detailed and intricate to be traced accurately from a photostat print, as described, are handled by a special method which eliminates the tracing. A photostat negative is made from the original drawing, and from this negative a light positive print to the proper dimensions is obtained. The desired line work is drawn with India ink directly on this light print, which is then bleached. The bleaching removes everything except the India-ink line work. The drawing is then ready to be type-stamped.

WHEN NECESSARY, DRAWINGS ARE SENT TO AUTHOR FOR APPROVAL

All drawings are checked at Society headquarters to assure their accuracy in editorial content and their perfection from the standpoint of producing a good engraving. Finished drawings are not sent to the author unless the data on such drawings are so highly technical as to warrant his final approval, or unless major changes have been made editorially. All corrections are indicated on the paper overlay, and the actual changes in line work and type are made by the Society, not by the author. Special mention of this is made here because in some cases when the Society has loaned its drawings to an author, they have been mistaken for engraving proofs and badly marked up with fountain pen ink, crayons, and the like. The author can expedite the publication of his paper by returning the corrected drawings promptly and by making no changes except those necessary in the interest of accuracy.

HANDLING OF ORIGINAL COPY

What about the damage that is likely to occur to copy for illustrations during all these processes? This query is frequently made by an anxious author. The answer is that special pains are taken to ensure that no harm is done to any such photograph or drawing. Written instructions on photographs are given in soft crayon, which is readily removed. Retouching and airbrushing are effected with water-soluble colors, which are removable by proper application of damped cloth or cotton, bringing the photographs back to their original state.

In handling valuable line drawings, once the first negative or positive print has been secured the original can be returned, the whole operation requiring less than a day. Engravers and draftsmen are fully aware of the value of these illustrations, and as a result loss or injury is well-nigh unheard of. For this reason the Society has frequently been privileged to borrow file drawings of great value not only for their intrinsic worth but for their official status. This courtesy is typical of the sincere cooperation afforded by authors—one of the most important factors ensuring the satisfactory presentation of illustrations in Society publications.

New Student Chapter at Brown University

BY RECOMMENDATION of the Committee on Student Chapters and confirmation of the Board of Direction at its Birmingham meeting, approval was given to the formation of a Student Chapter at Brown University, Providence, R.I. In the 1935 *Year Book* 110 Chapters are listed. Subsequently the formation of one at Dartmouth College was approved at the Board's Miami meeting. Brown University, therefore, furnishes the one hundred and twelfth Chapter in the Society. It is of interest that one of Brown's alumni served as Society President in 1916 in the person of Elmer L. Corthell.

New Memoirs of Deceased Members Available

CIVIL ENGINEERING history over a period of 65 years is reflected in the 14 memoirs of deceased members lately made available in preprint form for advance distribution to those who request them. To list the activities in merest outline would be to write a fairly complete description of civil engineering in all its branches—highways, railways, and waterways; bridges, buildings, dams, tunnels, harbors, oil lines, canals, and ships; engineering in the World War; prospecting in the Yukon Valley; construction in South America, Cuba, and Hawaii; and engineering teaching. These are some of the experiences recounted in the following memoirs.

In spite of its constant efforts, the Society is often unable to secure an adequate memoir of a deceased member and thus it is that there are many vacancies in the total list. The Society is particularly anxious to secure the memoirs of older members whose records for some reason have been missed. It is only by generous and wholehearted cooperation on the part of interested persons that this phase of the Society's work can be made completely effective. The following additional memoirs of deceased members are now available:

James Pierson Allen	1848–1934
George Washington Armitage	1876–1935
Ernest Harry Cornelius	1890–1934
Harry Carter Gardner	1881–1935
Frederick Nathaniel Hatch	1885–1934
Ralph Daniel Hayes	1881–1935
William Caswell Smith Lemen	1873–1935
Ira Welch McConnell	1871–1933
Marshall Morris	1877–1935
Harry de Berkeley Parsons	1862–1935
Stephen Allen Roake	1874–1935
Albert Orange Smith	1877–1934
Charles Voetsch	1877–1935
George Clinton Ward	1863–1933

Work for Junior Members

By J. T. L. McNEW, M. AM. SOC. C.E.

CHAIRMAN, COMMITTEE ON JUNIORS; PROFESSOR OF HIGHWAY ENGINEERING, AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS, COLLEGE STATION, TEX.

FOR SEVERAL YEARS the Society has been actively engaged in studying ways and means by which it might increase the advantages of Junior membership. Juniors themselves have joined in the task of solving the problem. That is as it should be, for the member, regardless of his grade, gets out of his society no more than he is willing to put into it. If the Juniors propose the successful solution, they reap the most benefit and have the satisfaction of knowing that they are helping to formulate the policy of an organized group of which they are a part.

JOHN T. L. MCNEW
Chairman, Committee on Juniors

If the solution of the problem of getting a larger measure of Junior participation in Society affairs is in reality a thing of mutual benefit, it will perhaps be wise to call attention to some of the things that may be done which are in keeping with established Society policy.

Local Sections offer the best medium through which Juniors may participate actively in the affairs of the Society. The Society has already requested that Local Sections include at least one Junior on each Section committee. A recent questionnaire addressed to the secretaries of the Local Sections shows this policy to be already in effect in approximately 72 per cent of the Sections. In addition, the Board of Direction has approved with enthusiasm the appointment of Juniors on all Society committees, as well as on the committees of the Technical Divisions. It is the sincere hope of the present Committee on Juniors that all the Local Sections will extend privileges of committee membership to their Junior members before January 1, 1936.

In Section activities, Juniors are probably better suited for certain assignments than are older members. They serve admirably on membership committees; they are particularly adept in making arrangements for meetings or entertainments; and above all, they are enthusiastic and willing to give service. A large percentage of the new members of the Society each year is made up of young men, just out of school and fired with an ambition to get into the profession—to take part in its activities and to meet and associate with other members. Surely no Local Section is so well off that it can fail to benefit from the enthusiasm and energy provided by the younger men.

Some Local Sections make use of their Juniors by placing them in sole charge of meetings from time to time. Others provide for a Junior forum, and some provide courses of instruction led by well-known engineers. All these things are for the advancement of the individuals concerned as well as for the creation of a spirit of fellowship and service to one another that is well worth the effort involved.

Juniors also have a duty to perform which is an obligation of membership. Under the rules of organization of Local Sections the Juniors are just as much members as anyone. There are no grades of membership. Juniors may and should attend, vote, speak, and discuss. Too many young men are timid and hold back from joining the Sections and attending meetings. Or perhaps they join and then await an invitation to attend, and if the invitation does not come they feel they are not wanted. Usually the truth of the matter is that the older members fear the meetings will be uninteresting to the younger men, and the older members are the timid ones. These are all misunderstandings or the result of a mutual timidity or self-consciousness that should not exist. Juniors owe it to themselves and to the Society to attend Section meetings and serve in any and every way they may.

One often hears the engineer accused of being an individual who dislikes association with others—an individual living apart, in a world where only facts, figures, and quantities make up the vocabulary. The Society furnishes a ground for the practice of fellowship that cannot be overlooked without loss to the individual. It is true of course that Juniors as a rule are young men new in the profession and as such are in positions where it may be difficult for them to leave a job to attend a meeting of engineers. Quite often, however, this is an excuse rather than a reason. If it is a valid reason then Juniors themselves may approach the Section officers and make suggestions that night meetings be held occasionally. The point of the question is that there are ways—many of them—in which Juniors may participate in Society affairs, and since there appears to be no valid reason for nonparticipation there should in reality be no problem.

Juniors need what the American Society of Civil Engineers has to offer them, and the Society needs the Juniors. What more can be said?

Prizes and Awards for Papers in "Transactions"

ON OCTOBER 14, 1935, by action of the Board of Direction, medals and prizes were awarded for 1934 papers incorporated in Vol. 99 of TRANSACTIONS. The papers for which these awards were made and their authors are given in the following list:

Norman Medal—To the late D. C. Henny, M. Am. Soc. C.E., for his paper entitled "Stability of Straight Concrete Gravity Dams."

J. James R. Croes Medal—To A. T. Larned and W. S. Merrill, Members Am. Soc. C.E., for their paper entitled "Actual Deflections and Temperatures in a Trial-Load Arch Dam."

Thomas Fitch Rowland Prize—To W. H. Kirkbride, M. Am. Soc. C.E., for his paper entitled "The Martinez-Benicia Bridge."

Arthur M. Wellington Prize—To Hawley S. Simpson, M. Am. Soc. C.E., for his paper entitled "Use and Capacity of City Streets."

Collingwood Prize for Juniors—To C. Maxwell Stanley, Jun. Am. Soc. C.E., for his paper entitled "Study of Stilling-Basin Design."

According to custom, these prizes will be officially presented at the first morning session of the Annual Meeting, that is on January 15, 1936. A forthcoming issue of CIVIL ENGINEERING will contain brief biographical sketches of the prize winners.

C. F. Scott Heads Engineers' Council

CHARLES F. SCOTT, professor emeritus of electrical engineering, Yale University, and chairman of the board appointed by Governor Cross to administer the recently enacted engineers' registration law in the State of Connecticut, was elected chairman of the Engineers' Council for Professional Development (E.C.P.D.) at the third annual meeting of that body held in New York, N.Y., on October 8, 1935. Professor Scott succeeds C. F. Hirshfeld, chief of research of the Detroit Edison Company, who has served as chairman of the Council since its formation.

The Engineers' Council for Professional Development is a conference of engineering bodies organized to enhance the professional status of the engineer through the cooperative support of the national organizations directly representing the professional, technical, educational, and legislative phases of the engineer's life. The participating bodies are the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, Society for the Promotion of Engineering Education, American Institute of Chemical Engineers, and the National Council of State Boards of Engineering Examiners.

George T. Seabury, Secretary of the American Society of Civil Engineers, was reelected secretary of the Council. New members of the executive committee also elected were C. F. Hirshfeld, representing the American Society of Mechanical Engineers; Harrison P. Eddy, of Boston, Mass., Past-President of the American Society of Civil Engineers, representing that society; and L. W. W. Morrow, managing editor of the *Electrical World*, New York, N.Y., representing the American Institute of Electrical Engineers. Other members of the executive committee who continue in office and the societies they represent are F. M. Becket, of New York, former president of the American Institute of Mining and Metallurgical Engineers; H. C. Parmelee, of New York, American Institute of Chemical Engineers; R. I. Rees, of New York, Society for the Promotion of Engineering Education; and D. B. Steinman, of New York, National Council of State Boards of Engineering Examiners.

After the meeting adjourned, the annual dinner, at which the chairman, C. F. Hirshfeld, presided, was held at the Engineers' Club, and was attended by about thirty representatives of the participating bodies and guests of the Council. A résumé of the work of the Council's four principal committees and of the actions of the annual meeting was reported by Dr. Hirshfeld. Professor Scott spoke on the significance of the Council's activities in carrying forward its program in a spirit of understanding and cooperation.

At the annual meeting, reports of the committees were presented and approved. These reports will be made public when printed. The principal activities of the Council are conducted under the guidance of four committees set up to cover the four phases of the engineer's training. These are the Committee on Student Selection and Guidance, charged with the pre-collegiate phases; the Committee on Engineering Schools, whose interests at present are directed toward carrying out a program of accrediting engineering curricula; the Committee on Professional Training, which gives its attention to the problem of the young engineer and recent graduate; and the Committee on Professional Recognition, whose concern is with procedures by which the individual becomes a recognized member of the engineering profession.

Because of misunderstandings of the purposes and objectives of the Committee on Professional Recognition that had arisen since the 1934 annual meeting, the Council adopted a resolution in which it regretted and disclaimed any statement that had been made in its behalf that might have been construed as unfriendly toward the engineers' registration movement, and any intention to set up a certifying agency in conflict with the legal registration of engineers by state boards or to parallel or supplant the National Bureau of Engineering Registration.

At the request of the Committee on Professional Recognition its "program of certification," adopted by the Council in October 1934, was referred back to the committee for further study and clarification.

Four New Honorary Members Elected

ONE OF THE MOST significant actions concluded at the Birmingham meeting of the Board of Direction was the election to honorary membership of John W. Alvord, John F. Coleman, Mortimer E. Cooley, and William J. Wilgus. All have been long notable in the profession, members of the Society for many years, and officers at some period of their careers.

Election to honorary membership is according to rules prescribed by the Constitution and is confined to "persons of acknowledged eminence in some branch of engineering or the sciences related thereto." The list of those noted engineers chosen for this honor, as well as the rigid conditions surrounding the elections are proof that only a selected group, relatively small and unquestionably suited for the highest honor in the Society, may be admitted.

A brief survey of the list of noted engineers just identified with this select membership will emphasize the strict limitations and the unusual requirements which guarantee that only those best fitted may succeed to honorary membership. Mr. Alvord, a leader in engineering thought and work in the Chicago District for many years, is senior partner of the firm of Alvord, Burdick and Howson. He has been a member of the Society since 1893 and was a Director in 1917–1918 and 1919–1921. Mr. Coleman has similarly been outstanding in the Mississippi delta region, as head of a consulting office in New Orleans under his own name. A member since 1901, he was Director, 1915–1917; Vice-President 1918–1919; and President in 1930. He is also serving as president of American Engineering Council. Dean Cooley has devoted most of his engineering career to the Middle West, where he served as professor and later dean of the colleges of engineering and architecture in the University of Michigan for a great many years. Latterly he has also been state engineer for the Federal Emergency Administration of Public Works in Michigan. He has been a Society member since 1911 and served as Director in 1914–1916. Colonel Wilgus, last of the group in alphabetical order, has to his credit important works for the New York Central Railroad in New York City, a distinguished war record, and eminent public service as director of the Emergency Relief Administration in New York City. He became a member in 1896 and served a term as Director, 1902–1904.

A more complete account of the activities of these noted engineers will be given in a later issue. The award of honorary membership will be officially conferred at the time of the 1936 Annual Meeting. Thus still greater prestige will redound to the outstanding group already known as the most illustrious members of the Society.

A Society Badge Makes an Excellent Christmas Gift

THIS is the season of the Christmas list. Everywhere people are making out lists of their relatives and friends but opposite the names too often there are—blanks. It is particularly difficult to find suitable gifts for the men of the family, who may have already collected too large a stock of ties, handkerchiefs, and cuff links.

Under such circumstances the question, "What shall I give him for Christmas?" may have a terrifying sound. Yet the answer may be easy to find if the man in question is connected with the American Society of Civil Engineers as an Honorary Member, Member, Associate Member, Affiliate, Junior, or member of a Student Chapter. All such are entitled to a Society badge.

The badge for the first four grades mentioned costs $5.00. It is a rich shade of blue enamel on solid gold, the gold showing as a border around the shield and in the lettering. It will be engraved with the member's name and membership grade. The pin for Juniors ($2.00) is similar in appearance except that it has a white border, and the pin for members of Student Chapters ($1.00) also has the white border but is maroon where the other pins are blue. Junior and student pins are not engraved.

For those who prefer them, charms for watch chains or fobs are available instead of pins. All pins are equipped with safety catches.

In ordering a pin to fill that gap in your Christmas list there are two things to remember—that no member may possess more than one pin at a time and that orders should be placed by December 1 if deliveries are desired by Christmas. If the member has never before had a pin, the order will be filled without question, but if his pin has been lost, then a statement to that effect must accompany the order. Orders should be forwarded to Society Headquarters, 33 West 39th Street, New York, N.Y.

The John Fritz Medal Awarded to W. F. Durand

AT THE ANNUAL MEETING of the John Fritz Medal Board of Award, the gold medal for 1936 was awarded to William Frederick Durand, for notable achievement "as authority in hydrodynamic and aerodynamic science, and in its practical application; outstanding leader in research and in engineering education." This award was made unanimously by a board having for its members 16 former presidents of the four Founder Societies—the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers.

Dr. Durand is professor emeritus of mechanical engineering at Stanford University, California. Among other honors, he was awarded the Daniel Guggenheim medal for aeronautical achievement in May 1935. He is a life member and gold medalist of the American Society of Naval Engineers and a former president of the American Society of Mechanical Engineers.

In 1925, Dr. Durand was appointed by President Coolidge a member and secretary of the Aircraft Board. He served as consultant to the U. S. Government on the Boulder Canyon project, the Grand Coulee project, and the All-American Canal. In March 1935, he was appointed by President Roosevelt as chairman of a committee on review of the entire question of airship design and construction for the U. S. Navy.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies Located in 40 States

Notes on the Work Relief Program

Approval of projects under the federal work relief program has been speeded up in recent weeks to make work available against the winter peak in operations. The jurisdiction of federal agencies over portions of the program has been clarified and funds have been shifted, especially to the Works Progress Administration, whose position is strengthened as a means of providing quick jobs. Discontinuance of the Division of Applications and Information and clarification of functions of the Advisory Committee on Allotments seem to place broad discretionary power under the state administrators and directors as to the carrying out of approved projects and the advancement of projects not yet approved. Engineers interested in individual projects should be reminded that the President insists upon the certification of each project by the Comptroller General, and conditions his approval upon that certification. It is further noted that numerous projects have been rescinded after their conditional approval.

The Works Progress Administration, the largest spending and employing agency of the program, has been given a high degree of flexibility through the approval of approximately twice as many projects as there is money to finance. In other words, each state has a pool of projects from which to draw in placing the jobless in work suited to their individual skills, with latitude as to the selection of projects at the time and place most needed. State administrators have been told that they must, in so far as possible, give work to all eligibles; must finish projects or project units once begun; and must plan purchases of materials so as to avoid either a shortage or a surplus. The expectation is that the WPA will handle work aggregating more than $1,000,000,000.

Of primary importance is the entrance of the Corps of Engineers of the Army into the WPA program. Lt. Col. F. C. Harrington has been appointed Chief Engineer of the WPA. Officers of the Corps have been appointed consulting field engineers in 11 areas of the United States. The consulting field engineers soon will visit their areas to secure full information as to the works program in each state, with "particular regard to those obstacles or difficulties which are hampering the speedy development of the program."

Specialized WPA phases of engineering significance include water conservation and irrigation projects now authorized for state WPA programs. Airports under WPA are subject to the approval and technical supervision of state representatives of the U. S. Bureau of Air Commerce. Planning, statistical, and research projects may be sponsored by state planning boards, aided by the state planning consultants of the National Resources Committee. Area statistical offices are being established to serve as clearing houses for reports on the work of all federal agencies entering the work relief program in the respective areas.

The Public Works Administration is going forward with a new program involving between 3,000 and 4,000 projects in which federal grants from new money and loans from the PWA revolving fund amount to about $500,000,000. With the addition of funds which the project sponsors have secured by private borrowings, the program amounts to about $750,000,000 of new construction. In addition, numerous projects are in various stages of construction under the old PWA program. Project sponsors have been warned that they must have contracts let and must be ready to start work on their PWA projects by the December 15 deadline set by the President. Otherwise their projects are likely to be rescinded and the funds transferred to other worthy jobs for which PWA has applications on file.

The PWA wage rates have been clarified so that projects under the old and the new PWA program are placed on the same basis. The "prevailing wage principle" is to be followed. The project applicant shall determine the wage rates "in accordance with local wage conditions" subject to the approval of the PWA state director. WPA wage schedules have been set on a population basis. PWA's new director of engineering is Capt. Jabez B. Gholston. He succeeds Clarence McDonough, who resigned to become general manager of the Lower Colorado River (Texas) Authority.

Employment Notes

Employment under the program on or about November 1 will be close to the approximate goal of 3,500,000 set for that date, in the belief of Federal officials. As of early October, the CCC was approaching a complement of 600,000; the WPA was employing about 500,000; and some hundreds of thousands were on State Emergency Relief Administration projects not yet transferred to the WPA, in addition to work being furnished by the PWA and other federal agencies entering the program.

Authority has been granted to exempt PWA projects from the requirement that 90 per cent of the labor be taken from relief rolls. Where insufficient relief labor of the necessary skill is available in the vicinity of a project, suitable workers may be selected through the U. S. Employment Service, with preference to bona fide residents of the political subdivision helping to finance the work. Provision may be made for supplying contractors with union labor with first preference to regular employees of the contractor who are on relief and with further preference to other union members who are on relief. A previous order also modified the relief labor requirement for PWA slum clearance employees.

Indefinite continuation of the Civilian Conservation Corps is contemplated in plans which call for a tapering off of enrolment from a peak of about 600,000 to 300,000 next July. Of approximately 750,000 young men who finish their formal education each year, some 600,000 are employable. On the basis discussed, the Corps could offer half of these a year of out-of-door work at some time in their young manhood. The age limit for enrolment, originally 18 to 25, has been widened from 17 to 28. WPA also plans to employ young men and women from 16 to 25, especially those from large relief families, to supplement the primary earnings of heads of families carried under the work program.

Other News Items

The Engineer's Duty as a Citizen, a pamphlet prepared as an outline for a discussion course at the Newark (N.J.) College of Engineering, is now in its third edition. The author, Roy V. Wright, editor of the *Railway Age* and other trade publications, has made revisions during the summer. The pamphlet seeks to outline, with specific examples, some of the ways in which engineers can discharge their civic responsibilities, as individuals or by group action. Copies are obtainable at 25 cents each from the Newark College of Engineering.

The annual meeting of the American Engineering Council will be held in Washington January 9, 10, and 11, 1936. The public affairs committee and the executive committee of the Council will hold meetings in Washington on November 1 and 2. Plans for securing the considered opinion of the enlarged membership of the Council at the annual meeting will be perfected in the November sessions, with special reference to the representation of new state and local engineering societies, of which some 15 have been elected to membership in the Council since the last annual meeting. The Council at the present time, through its member organizations, represents 38 engineering bodies composed of 7 national societies and 31 state and local engineering organizations.

Washington, D.C.
October 15, 1935

Preview of Proceedings

By HAROLD T. LARSEN, *Editor*

Two hydraulics papers, one on pile-loading tests, and one on structural analysis constitute the schedule for the November issue of "Proceedings," due to appear on the 15th of the month. In addition to these papers, there will be a number of discussions and closing discussions of more than ordinary interest.

LATERAL PILE LOADING TESTS

Although many field tests have been made to determine the vertical load-carrying capacity of piles, it appears that tests to determine the resistance of groups of piles to movement under lateral loads are far too few. In a paper entitled "Lateral Pile Loading Tests," which will appear in the November issue, L. B. Feagin, Assoc. M. Am. Soc. C.E., describes the lateral loading tests conducted by the Corps of Engineers, U. S. Army, in connection with the construction of Twin Locks No. 26 in the Mississippi River at Alton, Ill.

The tests were made by fixing the butts of the piles in specially constructed concrete monoliths, and then jacking the monoliths apart by means of a 350-ton hydraulic jack. The movement under a wide range of loads was observed, as well as the permanent deflection or set which remained after various loads were released.

In order to determine whether or not the total resistance of a group of piles is directly proportional to the number of piles in the group, tests were made on groups of 4, 12, and 20 piles, including four concrete piles, all with butts fixed in the concrete monoliths to simulate true foundation conditions. Tests were also made on single, timber and concrete, piles with butts not fixed. From these tests it was concluded that, for lateral unit loads up to about 6.5 tons per pile on a group of piles arranged in two rows as under the test monoliths, the total resistance to movement increases in direct proportion to the number of piles. As the unit lateral load increases above about 6.5 tons per pile, this reasoning no longer applies and the resistance per pile becomes less as the number of piles in the group increases. Conclusions were also reached regarding allowable unit lateral loads for certain permissible lateral movements, the conclusions being limited, of course, to sand similar to that in which the tests were made.

The tests indicated that a much greater part of the resistance to movement is supplied by the passive resistance of the soil than by the structural rigidity of the pile itself. Mr. Feagin concludes, however, that in view of the fact that the line of support lies below the ground surface, the structural rigidity in the top few feet of the pile is of great importance in limiting lateral movements within the limits contemplated under normal allowable design loads.

TRUSS DEFLECTION: THE PANEL DEFLECTION METHOD

Under the title, "Truss Deflection: The Panel Deflection Method," Louis H. Shoemaker, M. Am. Soc. C.E., advances a method of computing the deflection of each point of a truss, both horizontally and vertically. It is claimed that this method is different from any that have previously appeared. In some ways it would seem to have considerable advantage over other methods because, as the calculations progress, the position of each and every panel intersection is determined. Essentially, the method does analytically what the Williot diagram does graphically. The paper may be said to be a mathematical innovation in that the complete deflection of all points of the structure can be found in one continuous operation by a purely analytical process. The author's treatment is concise, this paper being one of the shortest that has appeared in PROCEEDINGS in many years. Two examples—one for the deflections of a simple truss and the other for the horizontal reactions of a two-hinged arch—demonstrate the essential features of his application.

INFLUENCE OF DIVERSION ON THE MISSISSIPPI AND ATCHAFALAYA RIVERS

Few subjects arouse more interest among civil engineers—and especially hydrologists—than the problems involved in controlling the flood flows of the Mississippi River. In his paper entitled "Influence of Diversion on the Mississippi and Atchafalaya Rivers," E. F. Salisbury, M. Am. Soc. C.E., concentrates on the questions that arise from the diversion of water from the Mississippi River through Old River into the Atchafalaya. The author's aim is to state facts such as those included in the twelve tables of the paper, to explain these facts as he sees them, to draw conclusions, and to summarize all available data on the subject. The discharge records involved are those for gages at Columbus, Ky., Helena, Ark.; Arkansas City, Ark.; Red River Landing, La.; Carrollton, La.; and Simmesport, La., from various reports of the Mississippi River Commission.

HYDRAULIC MONITOR FOR FIRE PROTECTION IN THE WATERSHED ABOVE ALTADENA AND PASADENA, CALIF.

Discussion by Arthur G. Pickett, Jun. Am. Soc. C.E., on "Flood and Erosion Control Problems and Their Solution"

The author has compiled a history of flood-control policies along the Atchafalaya River since 1804, indicating their long-time effects from the viewpoint of the various premises of this paper and he introduces a term "efficiency influence" to denote the capacity of a silt-laden river to do more work at one time than another. For example, it will discharge a given volume of water at different gage heights, depending upon its physical condition and the movement of the water. All the gage records throughout the paper are adjusted so as to be comparable and are discussed in terms of this efficiency. The author claims that a vicious cycle of conditions is established by an unrestricted diversion of flow from the Mississippi River into the Atchafalaya, which results in a large loss in efficiency.

STABLE CHANNELS IN ERODIBLE MATERIALS

The All-American Canal now being constructed in southern California is the largest irrigation canal in the United States. This project, which will irrigate a large area in the Imperial Valley, now supplied by a canal passing through Mexico, will be wholly in the United States—hence, the name "All-American." The canal will take its water supply from the Colorado River, which carries a very high concentration of silt. Extensive works will be built to remove most of this silt, and only very fine material will enter the canal. The location is such that a major saving will be possible if a relatively narrow canal can be used. The question of a stable channel section thus becomes important. The results of the study made to investigate the factors controlling the shape of a channel conducting water are given in a forthcoming paper by E. W. Lane, M. Am. Soc. C.E., entitled "Stable Channels in Erodible Material."

DISCUSSIONS

A group of interesting discussions on the current papers (for the list of current papers see the fly-leaf of PROCEEDINGS) will also appear. For example A. E. Cummings, Assoc. M. Am. Soc. C.E., has written a discussion of the paper by Mr. Feagin treating the subject of lateral pile loads from the theoretical viewpoint. The results are interesting as a check on the experimental results published in the main paper.

Three papers that have elicited discussion for many months will be closed by the authors in the November issue of PROCEEDINGS: "Relation Between Rainfall and Runoff from Small Urban Areas," by W. W. Horner, M. Am. Soc. C.E. and Frank L. Flynt, Assoc. M. Am. Soc. C.E.; "The Silt Problem," by J. C. Stevens, M. Am. Soc. C.E.; and "Weights of Metal in Steel Trusses," by J. A. L. Waddell, M. Am. Soc. C.E.

News of Local Sections

CINCINNATI SECTION

A meeting of the Cincinnati Section was called to order at the Engineers Club on October 7, with 35 members and guests present. After a brief business session C. M. Stegner, president of the Section, discussed the new Technical and Scientific Societies Council of Cincinnati. The speaker of the evening was Robert Miller, who presented a comprehensive paper on "Soil Mechanics and Pile Foundations." Two brief discussions on the proposed Hamilton County charter, to be presented to the electorate in November, were then given.

DETROIT SECTION

At the annual meeting of the Detroit Section of the Society, held on October 11, the following officers were elected for the ensuing year: M. R. Fisher, president; W. C. Hirn, first vice-president; R. L. McNamee, second vice-president; and L. C. Wilcoxen, secretary-treasurer.

After a business session the meeting was turned over to Talbert Abrams, who gave an illustrated talk on aerial surveying.

GEORGIA SECTION

The Georgia Section of the Society met on October 7 in Atlanta. The business session included the reading of a report of the committee on employment. During the technical part of the program a helpful talk on the construction of landing fields and airports was given. There were 28 members and guests in attendance.

LOS ANGELES SECTION

A dinner meeting of the Los Angeles Section was held at the University Club in Los Angeles on October 9, with 200 in attendance at the dinner and about 225 at the meeting. The guests of honor included Edward M. Markham, Chief of Engineers, U. S. Army; Thomas H. Jackson, of the Corps of Engineers, U. S. Army; Theodore J. Wyman, Jr., district engineer in charge of control projects in the Los Angeles area; L. C. Hill, former Vice-President of the Society; Dudley S. Corlett, former British army officer; and John M. Server, Jr., newly elected executive secretary of the Junior Forum. Brief talks were given by General Markham, Colonel Jackson, and Mr. Server. Following a short intermission, the technical program was initiated with a talk on the Ethiopian crisis and its significance given by Captain Corlett, who served in Ethiopia during the World War. Then Major Wyman gave an illustrated address on the Fort Peck project in Montana. By means of slides and maps of the Missouri River drainage area, he detailed the history of the river, and the need for and benefits to be derived from the project.

METROPOLITAN SECTION

The problems attendant on commuting between the northeastern counties of New Jersey and Manhattan gave the Metropolitan Section of the Society the subject for its first meeting of the year, which was held in New York City on October 16. The principal paper was presented by L. Alfred Jenny, who it is said made the first proposal (in 1921) for a loop rapid-transit system, whose west side would parallel the Hudson River on the New Jersey side and whose east side would extend in Manhattan south to Wall Street. Major Jenny's present plan shows the same basic pattern, but he would build initially only the uptown river crossing and the Manhattan Island line. All the route would be in subway, providing a double-track line with clearances for standard railroad equipment. The river tunnel would be placed at 50th Street, instead of 57th, as proposed in most other plans, so as to provide a wider "walking belt" between the line and Central Park at 59th Street and so as to serve the populous Rockefeller Center region. The western terminus in New Jersey would be at an intersection with the Erie Railroad. On the east side the subway would extend down Fifth Avenue and on south to Wall Street. Speakers who discussed the paper were Russel S. Wise, Glenn S. Reeves, and Harold M. Lewis. VanTuyl Boughton, new president of the Section, presided. The attendance was about 200.

On September 24 Dr. David B. Steinman delivered an address to 100 members of the Junior Branch of the Metropolitan Section entitled "Engineers' Registration and Related Problems of the Profession." On Saturday, October 5, 40 Juniors made an inspection trip to the Triborough Project. At the October 8 meeting three members—Harold S. Farney, George L. Curtis, and Daniel J. Liccione—delivered short talks, which elicited lively discussion. The subjects were: "The Present Relief Program," "Scrapping the Constitution," and "Observations of a Young Engineer." On October 22, A. Daniel Hunter, C.E.C., U. S. Navy, gave an illustrated talk on the work of the civil engineer in the Navy.

NEBRASKA SECTION

At a meeting of the Nebraska Section held in Lincoln on September 28 the following officers were elected for the ensuing year: John C. Detweiler, president; R. M. Green, vice-president; and R. E. Edgecomb, secretary-treasurer. Following a business session, papers were presented by F. T. Darrow, assistant chief engineer of the Chicago, Burlington and Quincy Railroad, and J. G. Mason, State Bridge Engineer of Nebraska. Both papers concerned engineering aspects of the Republican River flood that took place in June of this year.

PHILADELPHIA SECTION

On Wednesday, October 16, the first meeting of the Philadelphia Section for the 1935–1936 season was held. This meeting was well attended, there being 65 members and guests present at the dinner preceding the meeting and 125 at the meeting. The chairman was Dudley T. Corning, chief of the Bureau of Highways of Philadelphia. The subject of the meeting was "Highways," the first speaker being H. K. Fairbank, chief of the Information Division of the U. S. Bureau of Public Roads. Mr. Fairbank, whose subject was "Highway Planning Surveys by the Bureau of Public Roads," gave a very comprehensive explanation of the road and traffic surveys about to be undertaken throughout every county in every state under the supervision of the Bureau of Public Roads. The next speaker was Nathan Smith, chief engineer of the State Roads Commission of Maryland, who discussed "Highway Work in Maryland," from its beginnings in 1898 until the present day. Then A. E. Keeley, assistant chief engineer of the Pennsylvania Department of Highways, gave the history of the development of the state system of highways since the organization of the department in 1903.

PORTLAND (ORE.) SECTION

There were 47 members and guests present at a meeting of the Portland (Ore.) Section held on September 11. The technical program for the occasion featured an interesting symposium on the subject, "Irrigation in the Willamette Valley," the speakers including Charles E. Stricklin, state engineer of Oregon; W. L. Powers, soil scientist at Oregon State College; and Arthur M. Piper, of the U. S. Geological Survey. Mr. Stricklin's talk stressed a comparison of rainfall data in the Willamette Valley region with data from other sections of the state; Dr. Powers discussed the subject from the point of view of soils in the valley and their relation to irrigation and drainage; and Mr. Piper made special reference to underground water supplies in the valley, which might be used for irrigation. An enthusiastic discussion of the subject followed from the floor.

SACRAMENTO SECTION

The Sacramento Section has recently held a series of weekly luncheon meetings, at which the members were privileged to hear a number of interesting speakers. The list included J. W. S. Butler, Sacramento attorney; Charles Hughes, superintendent of schools in Sacramento; Drury Butler, former president of the Section; J. B. Maloney, superintendent of recreation in Sacramento; and Alex Ashen, attorney for a large group of newspapers. The average attendance at these sessions was 20.

SAN DIEGO SECTION

After the summer vacation regular monthly meetings of the San Diego Section were resumed with a session held on September 26. The feature of the occasion was a talk by D. Arnold Lane, secretary of the Los Angeles Section, who is connected with the Los Angeles Bureau of Water and Power. Mr. Lane described the Mono Lake project, which will increase the Los Angeles water supply. His talk was illustrated with lantern slides and motion pictures.

SAN FRANCISCO SECTION

A regular dinner meeting of the San Francisco Section was held at the Engineers' Club on October 15. There were 125 present at the dinner, which was followed by a program of entertainment. N. A. Bowers introduced C. R. Riddle, job engineer for the Mason-Walsh-Atkinson-Kier Company, general contractors on the construction of Grand Coulee Dam. Mr. Riddle presented an interesting description of the progress of construction on this project. During the business session Harmer E. Davis gave a talk on the Junior Forum, in which he stated that it is the aim of the forum to train Juniors to take an active part in the affairs of the Society; to stimulate the interest of Student Chapter members in universities in the region; and to promote professional and social fellowship among the members of the forum. He also stated that there will be bimonthly meetings, at which formal papers will be presented.

In amplification of the account of the August 20th meeting of the Section, which was published in the October issue of CIVIL ENGINEERING, the technical program that evening was devoted to a discussion of the legislative aspects of engineering practice under the California registration act. Addresses were made by Walter J. Huber, F. C. Herrmann, L. H. Nishkian, H. J. Brunnier, and Anthony J. Kennedy, attorney.

ST. LOUIS SECTION

The St. Louis Section was fortunate in having Henry E. Riggs, Vice-President of the Society, as principal speaker at its meeting held on September 23, the first following the summer vacation. Mr. Riggs gave a résumé of the history of the Society and discussed its present problems. There were 42 present.

TACOMA SECTION

On September 9 the regular meeting of the Tacoma Section was held in the Olympian Hotel in Olympia, Wash., with 59 in attendance. After a brief business session talks were given by Wells Ashley, of the Hydraulics Department of the State of Washington; E. R. Hoffman, acting director of the Public Work Administration in Washington; and the Honorable Clarence D. Martin, governor of the state. Governor Martin gave an inspiring talk on the needs of the state and the nation.

Student Chapter Notes

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

During the 1934–1935 school year the Agricultural and Mechanical College of Texas Student Chapter held ten meetings and two banquets. In the spring two inspection trips were made to Houston and Dallas, Tex., where various engineering projects were studied. Members of the Chapter were instrumental in making the annual engineers' day a great success. Among their exhibits for the occasion were scale models of a steel highway bridge and mill building and models of a reinforced concrete culvert and wooden railroad trestle. All the laboratories were open for inspection, and demonstrations were performed by the students.

COLLEGE OF THE CITY OF NEW YORK

The College of the City of New York held 20 meetings during the past year, which attracted a total attendance of 750. The technical programs presented on these occasions were in charge of students and outside speakers who read papers on various timely topics. In the fall members of the Chapter attended the Metropolitan Conference of Student Chapters held in Newark, and in the spring they were hosts for a similar conference. Prominent on the list of social and recreational activities sponsored by the Chapter during the year were athletic events, dinner dances, and smokers.

CUSTIS LEE ENGINEERING SOCIETY (WASHINGTON AND LEE UNIVERSITY)

Papers prepared by students were presented at the meetings of the Washington and Lee University Student Chapter held during the past year. These proved of considerable interest and often stimulated enthusiastic discussion from the floor. In all, there were nine meetings, with a total attendance of 75.

UNIVERSITY OF IDAHO

During the past school year the University of Idaho Student Chapter enjoyed several picnics and outdoor athletic events. In April an inspection trip was taken to such points of engineering interest as Grand Coulee Dam, the Millwood paper mill, and water power stations in Spokane. A study of bridge types in Spokane was also made. An interesting feature of the Chapter's activities was the publication of a monthly engineering periodical known as *The Rock Crusher*. A new staff is appointed for each issue, thus giving a number of students the benefit of organizing and editing a paper.

UNIVERSITY OF MICHIGAN

Varied programs of entertainment and instruction were presented at the 16 meetings held by the University of Michigan Student Chapter during the recently completed school year. Among the outside speakers who appeared at these sessions were Henry E. Riggs, Vice-President of the Society; R. A. Kirkpatrick, of the Union Pacific Railroad Company; and Walter E. Jessup, Field Secretary of the Society. In the spring interest centered in the engineering open house, which was held on May 17 and 18. On April 4 an inspection trip was made to the Detroit Water Works and to the Rouge River plant of the Ford Motor Car Company.

UNIVERSITY OF MINNESOTA

The University of Minnesota Student Chapter held eight meetings during the 1934–1935 school year, with a total attendance of 806. In November the Chapter was entertained by the Northwestern Section of the Society at a dinner meeting, and later in the same month it sponsored a joint meeting of the student branches of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers. On the latter occasion slides and motion pictures of Boulder Dam were shown through the courtesy of the Babcock and Wilcox Company. One of the social events of the late winter was a dance held at the Glenwood Chalet under the joint sponsorship of the Chapter and the Chi Epsilon honorary fraternity.

UNIVERSITY OF MISSISSIPPI

Illustrated lectures loaned by the Society were enjoyed at a number of the 1934–1935 meetings of the University of Mississippi Student Chapter. Despite the fact that the Chapter was only recently organized, it engaged in a number of activities during the year. Early in the second semester it undertook to edit two pages in *The Mississippian*, the university's weekly newspaper. In these pages a great deal of information concerning the engineering school was presented. Through the courtesy of the U. S. Bureau of Reclamation the Chapter showed a four-reel motion picture of Boulder Dam, which was enjoyed by a large number of university students.

UNIVERSITY OF MISSOURI

Several inspection trips formed an interesting feature of the activity of the University of Missouri Student Chapter during the past year. St. Louis, Kansas City, and Alton, Ill., were among the points visited on these trips, which included inspection of numerous engineering projects under construction along the Mississippi and Missouri rivers. On November 24 members of the Chapter were guests of the St. Louis Section of the Society at a dinner meeting, which was also attended by representatives of other Student Chapters. The principal speaker on this occasion was George T. Seabury, Secretary of the Society. In all there were seven meetings, with a total attendance of 127.

MISSOURI SCHOOL OF MINES AND METALLURGY

The annual report of the Missouri School of Mines and Metallurgy states that there was 100 per cent enrolment of those eligible for membership in the Chapter during the past year. The technical programs, presented at the twelve meetings, featured a number of interesting speakers, the list including E. L. Daley, of the Corps of Engineers, U. S. Army; Carl W. Brown, assistant chief engineer of the Missouri State Highway Department; C. L. Sadler, topographical engineer of the U. S. Geological Survey; and J. K. Walsh, of the Hercules Powder Company.

MONTANA STATE COLLEGE

Student papers on a wide variety of engineering topics formed the nucleus of entertainment at the 1934–1935 meetings of the Montana State College Student Chapter. The 18 meetings held during the year attracted a total attendance of 896.

UNIVERSITY OF NEBRASKA

Students, members of the faculty, and outside speakers collaborated in providing the technical programs at the twelve meetings of the University of Nebraska Student Chapter held during the past school year. T. A. Leisen, Director of the Society and general manager of the Metropolitan Utilities District of Omaha, was the speaker on one occasion. In May members of the Chapter took an active part in preparing for the annual engineers' week, and three of its exhibits were specially featured.

UNIVERSITY OF NEW HAMPSHIRE

The 1934–1935 report of the University of New Hampshire indicates that the past year has been successful from the standpoint of both 100 per cent enrolment and the variety of activities engaged in. Students presented a number of papers on timely engineering topics at the 26 meetings, and several outside speakers were heard. Among these were W. J. D. Reed-Lewis, of the Lawrence Portland Cement Company; John Morton, soils engineer of the New Hampshire State Highway Department; Charles Colburn, sales engineer of the Standard Oil Company; T. Alfred Fleming, of the National Board of Fire Underwriters; E. P. Gallagher, of the Brick Manufacturers' Association; and R. R. Zipprodt, of the Portland Cement Association.

NEW MEXICO STATE COLLEGE

Outside speakers addressed a number of the 1934–1935 meetings of the New Mexico State College Student Chapter. The list of these speakers included C. Frank Allen, author of one of the textbooks used in the engineering course at the college; William Turner, city engineer of Las Cruces, N.M.; H. B. Elmendorf, project manager of the Hope Irrigation Readjustment Project in Hope, N.M.; and Ralph Charles, state project manager. The Society's illustrated lectures were shown at a number of meetings.

NEWARK COLLEGE OF ENGINEERING

The Newark College of Engineering Student Chapter reports that its activities during the past year took the form of nine meetings, which were addressed by students, members of the faculty, and outside speakers. Among the latter were D. B. Steinman, consulting engineer; Robert Ridgway, Past-President of the Society; and Charles Breed, head of the Department of Civil and Sanitary Engineering at Massachusetts Institute of Technology. In December the Chapter was host to the Metropolitan Conference of Student Chapters.

NORTH CAROLINA STATE COLLEGE

The high point of the 1934–1935 school year for the North Carolina State College Student Chapter was participation in the annual engineers' fair, which was held on April 4, 5, and 6. The Chapter was represented in the exhibits by the display of a model dam and a model four-leaf clover highway intersection, which elicited much favorable comment. Later in the same month members of the Chapter were guests of the North Carolina Section of the Society at a meeting that took place in Durham, N.C. A number of meetings were held during the year.

NEW YORK UNIVERSITY

Varied technical programs were enjoyed by the New York University Student Chapter at their 14 meetings held during the 1934–1935 school year. Talks were given by J. P. Growdon, chief engineer of the Aluminum Company of America; Arthur G. Hayden, designing engineer of the Westchester County Park Commission; and D. B. Steinman, consulting engineer. One of the most successful events of the year was the alumni dinner and smoker held on January 17.

NORTH DAKOTA STATE COLLEGE

Of the six meetings held by the North Dakota State College Student Chapter during the past school year three were devoted to business, one to the showing of a film on engineering work, and two to the presentation of short talks by W. E. Smith, assistant professor of civil engineering at the college. In all, the meetings were attended by 120.

OHIO NORTHERN UNIVERSITY

The Ohio Northern University Student Chapter boasts that its enrolment for 1934 and 1935 was 100 per cent of those eligible for membership. A number of meetings were held during the year, and these were addressed by members of the faculty and Chapter who spoke on a variety of timely topics. In May an inspection trip was made to Defiance and Toledo, Ohio, where the water supply and sewage treatment plants were inspected.

OHIO STATE UNIVERSITY

An unusually successful school year was recently completed by the Ohio State University Student Chapter, the program including seven dinner meetings, a dance, and athletic and debating events. Among the outside speakers who appeared at the meetings were William Burroughs, of the Ohio State Highway Department; L. A. Boulay, head of relief work in central Ohio; and Walter E. Jessup, Field Secretary of the Society.

UNIVERSITY OF OKLAHOMA

Members of the University of Oklahoma Student Chapter prepared many interesting engineering exhibits during the 1934–1935 school year. Some of these were displayed at the engineers' open house held in the spring, and the model of two end sections of a curved chord highway bridge has been made a permanent feature of the equipment in the design laboratory. At some of the meetings held during the year outside speakers were heard, the list including T. Warren Allen, of the U. S. Bureau of Public Roads, and T. G. Banks, of the Oklahoma City Water Department. Illustrated Society lectures were shown on some occasions, and a motion picture of construction on Boulder Dam was shown through the courtesy of the U. S. Department of the Interior.

MEMBERS OF THE UNIVERSITY OF OKLAHOMA STUDENT CHAPTER

OREGON STATE COLLEGE

Members of the Oregon State College Student Chapter participated in the annual engineers' day at the college held in the spring of the 1934–1935 school year. Other high lights of the year were inspection trips to Bonneville Dam and to study the bridges of the Oregon Coast Bay region. Eleven meetings, with a total attendance of 480, were held.

PENNSYLVANIA MILITARY COLLEGE

Students furnished the technical programs for most of the seven meetings held by the Pennsylvania Military College Student Chapter during the past school year. In the spring the Chapter

entertained the Villanova College Student Chapter and attended the annual Student Chapter convention held at Swarthmore College. A visit was also made to the Franklin Institute in Philadelphia.

PENNSYLVANIA STATE COLLEGE

One of the important activities of the Pennsylvania State College Student Chapter during the past year was the publication of a mimeographed bulletin, which appeared at regular intervals. This sheet is called *The Penn State Tripod*. Students and members of the faculty collaborated in furnishing programs for the nine meetings held during the year. These sessions had a total attendance of 286.

UNIVERSITY OF PITTSBURGH

The school year 1934–1935 was an interesting one for the University of Pittsburgh Student Chapter. Besides holding weekly meetings, the Chapter has taken an active part in the other events of the university campus. Members of the faculty and representatives of various Pittsburgh industries were among the speakers on these occasions. The list included A. H. Roberts, of the Westinghouse Electric and Manufacturing Company; John M. Fitzgerald, vice-chairman of the Committee on Public Relations of Eastern Railroads; T. A. Fleming, of the National Board of Fire Underwriters; and J. C. Barton, director of the university's placement bureau.

PRINCETON UNIVERSITY

The 1934–1935 activities of the Princeton University Student Chapter included three meetings and an inspection trip to New York City to view construction progress on the new mid-town Hudson tunnel. This trip was arranged through the courtesy of C. S. Gleim, engineer in charge of construction. Those who addressed the meetings were W. S. Roop, of the New York Shipbuilding Company, and Montgomery B. Case, consulting engineer of Philadelphia, Pa.

PURDUE UNIVERSITY

Seven meetings, with a total attendance of 725, were held by the Purdue University Student Chapter during the past school year. Illustrated lectures on current engineering projects were enjoyed on most of these occasions. In April the Chapter sponsored a banquet for all the civil engineering students and members of the faculty and also arranged a meeting at which sound films on the Tennessee Valley Authority projects were shown. The latter meeting attracted a very large attendance because of widespread interest in the subject. The films were shown through the courtesy of the Conservation Department of Indiana.

RHODE ISLAND STATE COLLEGE

The Rhode Island State College Student Chapter reports the completion of a successful school year. In the spring interest centered in the annual open house held by the School of Engineering. The civil engineering features of the exhibit were handled by members of the Chapter, who constructed models of Pratt trusses, a sedimentation tank, and concrete beams to show breaking along lines normal to the planes of greatest stress. In all, there were five meetings, with a total attendance of 118.

RICE INSTITUTE

Three inspection trips to local points of engineering interest were enjoyed by the Rice Institute Student Chapter during the past school year. Students, members of the faculty, and outside speakers collaborated to make the technical programs presented at the 12 meetings interesting and varied. At some of the sessions illustrated lectures furnished by the Society were shown.

ROSE POLYTECHNIC INSTITUTE

The 1934–1935 report of the Rose Polytechnic Student Chapter calls attention to its 100 per cent enrolment. The meetings were interesting and varied. The November session took the form of an all-day program sponsored by the University of Illinois Student Chapter. On this occasion members heard an illustrated lecture on the construction of Boulder Dam, given by J. L. Savage, chief designing engineer of the U. S. Bureau of Reclamation, and visited a number of points of engineering interest. Among the outside speakers heard at the meetings were M. R. Keefe, chief designing engineer of the Indiana State Highway Commission, and H. O. Wimsett, chief locating engineer of the same organization.

RUTGERS UNIVERSITY

During the 1934–1935 school year the Rutgers University Student Chapter held nine meetings of a business and social nature, two lectures, and three inspection trips. The lectures, which were illustrated, were given by R. R. Zipprodt, engineer in charge of research of the Portland Cement Association, and Robert Ridgway, Past-President of the Society. The inspection trips included visits to the sewage disposal plants at Bernardsville, Princeton, and Perth Amboy, N.J., and to the midtown Hudson tunnel now being constructed in New York City.

SOUTH DAKOTA STATE COLLEGE

The Society's illustrated lectures were shown at several of the seven meetings held by the South Dakota State College Student Chapter during the 1934–1935 school year. Students and members of the college faculty were in charge of the programs presented at some of these sessions.

SOUTH DAKOTA STATE SCHOOL OF MINES

Students, members of the faculty, and outside speakers combined to make the 1934–1935 meetings of the South Dakota State School of Mines memorable. In all, there were six meetings with a total attendance of 114. In May a special inspection trip was made to Lead, S.D., for the purpose of observing building and trestle construction in the shaft and engine room of the Kirk Power Station.

UNIVERSITY OF SOUTHERN CALIFORNIA

The 1934–1935 meetings of the University of Southern California Student Chapter have taken the form of engineering lectures, student discussions and business meetings, and athletic events. Among the outside speakers who have addressed gatherings are W. C. Emmett, district engineer of the American Institute of Steel Construction, and Alfred Jones, president of the Los Angeles Section of the Society. There were 14 meetings with a total attendance of 216.

STANFORD UNIVERSITY

The 1934–1935 report of the Stanford University Student Chapter states that the Chapter has enjoyed an interesting and active year that included six business meetings, five social meetings, six special meetings, and two inspection trips. Whenever possible, members of the Chapter have availed themselves of the privilege of attending meetings of the San Francisco Section of the Society. Among the speakers at the meetings were Harrison P. Eddy, Past-President of the Society; C. H. Purcell, chief engineer of the San Francisco–Oakland Bay Bridge; Frank G. White, of the Board of State Harbor Commissioners; Bailey Willis, emeritus professor of geology at Stanford University; and F. H. Tibbetts, civil engineer of San Francisco, Calif.

STATE COLLEGE OF WASHINGTON

Interesting and varied programs were enjoyed by the State College of Washington Student Chapter in 1934–1935. Talks were given by members of the faculty and student body and by outside speakers. The illustrated lectures furnished by the Society also formed a helpful feature of the programs.

UNIVERSITY OF TEXAS

The University of Texas Student Chapter announces that the 1934–1935 school year was very successful. In all, there were 16 meetings, with a total attendance of 558. The programs at these sessions were furnished largely by students and outside speakers. Among the latter were Paul J. McCombs, state land surveyor; V. M. Ehlers, chief engineer of the Texas State Health Department; Don Lee, secretary of the Texas Contractors' Association; R. F. Dawson, testing engineer for the Texas Bureau of Engineering Research; and R. J. McMahon, technical assistant in the Texas State Reclamation Department. Inspection trips were made to the Austin water plant and to various engineering and industrial features of interest in Houston. In May the Chapter sponsored the civil engineering displays at the annual engineers' power show.

ITEMS OF INTEREST

Engineering Events in Brief

CIVIL ENGINEERING for December

ONCE AGAIN, in an effort to carry to every member as much as possible of the spirit and inspiration of the Society's meetings, CIVIL ENGINEERING will be expanded to accommodate abstracts of papers presented at such a gathering.

The general meetings and technical sessions of the Fall Meeting at Birmingham, Ala., produced a wide variety of timely papers. Pros and cons of the govermental policies exemplified in the Tennessee Valley Authority were warmly discussed at the meeting, and formed the basis of a number of papers, which illustrate the interest engineers are taking in current economic questions. The more technical aspects of engineering activity are reflected in articles on surveying, mapping, and sanitation, and on the construction of bridges, dams, roads, and drainage works. Attention is concentrated in all these papers on the particular problems and projects of the Southeast.

Philadelphia's First Water Supply

IN 1789 Benjamin Franklin first drew the attention of Philadelphia to the necessity of a pure water supply. There were no immediate results, although Franklin reinforced his arguments by providing $100,000 in his will for a water supply system.

After an epidemic of yellow fever in 1793, the question again was brought to the fore, and in July 1798 the city council engaged Benjamin Henry Latrobe, an engineer of "superior talent and industry," to investigate the whole subject. In December of the same year, Latrobe reported his views "as to the practicability and means of supplying a sufficiency of wholesome water for culinary use, and an additional supply for washing the streets, and if possible, for cooling the air." The problem of air conditioning thus seems to have received official notice almost a hundred and fifty years ago. His recommendation for a reservoir and pumping station in Centre Square—the site of the present City Hall—was adopted in January 1799, and the work was commenced in March of the same year under his personal direction. The plant went into operation on January 27, 1801.

At that time there were only three steam engines of any considerable size in the country. Nicholas J. Roosevelt, of the Soho works, on the Passaic River in New Jersey, was given a $30,000 contract for the construction and erection of two steam engines capable of pumping 3,000,000 gal per day to a height of 50 ft and for their

CENTRE SQUARE WATER WORKS AT PHILADELPHIA, FROM AN EARLY ETCHING
Occupying the Site Where the City Hall Now Stands, This Pumping Station Went Into Operation in 1801

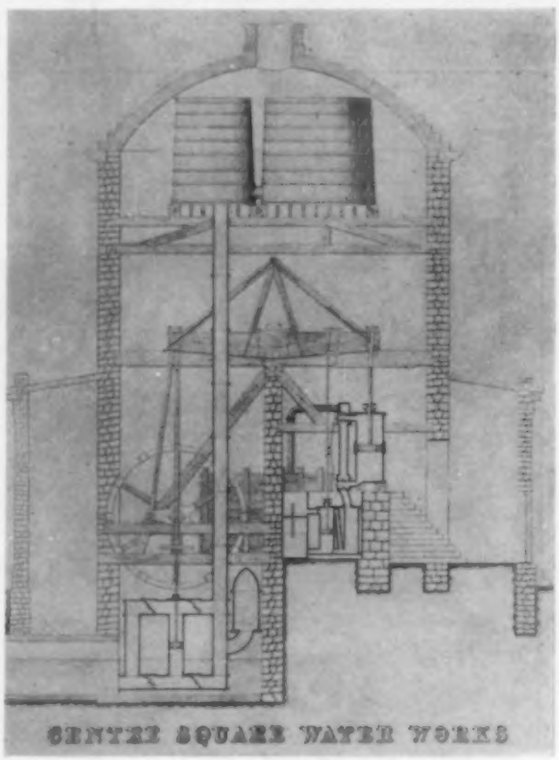
maintenance and repair over a period of five years. It is believed that these steam engines were the largest that had been constructed in the United States up to that time and that they represent the first application of steam to the pumping of water in this country.

The lever beams, fly wheels, shafts and arms, cold water pumps and cisterns were all made of wood, as shown in the sectional elevation. "The main steam cylinder was cast in two pieces, united by copper, the joints being secured externally by a cast-iron band 18 in. wide; and although it was but 6 ft 6 in. long, and 36 in. in diameter, nearly four months were occupied in boring it out fit for use."

The building housing the water works, as shown in an illustration, was made of marble in the form of a 60-ft square 25 ft high, around a circular shaft 40 ft in diameter and 60 ft high. The shaft was capped by a dome, through the center of which the smokestack was carried. Water was pumped up 50 ft from a brick tunnel into two tanks of "17,094 ale, or 20,868 wine gallons capacity." The pumps were 18 in. in diameter, with 72-in. stroke.

Notwithstanding the fact that the engines were reported to have been "very defective in every respect," the plant was operated until September 1816. It was taken down in 1828.

CIVIL ENGINEERING is indebted to Lyle L. Jenne, Assoc. M. Am. Soc. C.E., for the information and illustrations in this article. The quotations are from a report of 1875.



SECTIONAL ELEVATION SHOWING STEAM CYLINDER, PUMP MECHANISM, AND CISTERNS

Ingenuity of Danish Engineers Overcomes a Difficult Foundation Problem

Little Belt Bridge, Denmark

A DIFFICULT pier foundation problem has been solved in a unique way by Danish engineers, enabling them to complete on schedule a long-needed bridge from the island of Fyen to the Jutland peninsula,

WORKING PLATFORM OF A PIER

over the Little Belt, a deep and narrow sound.

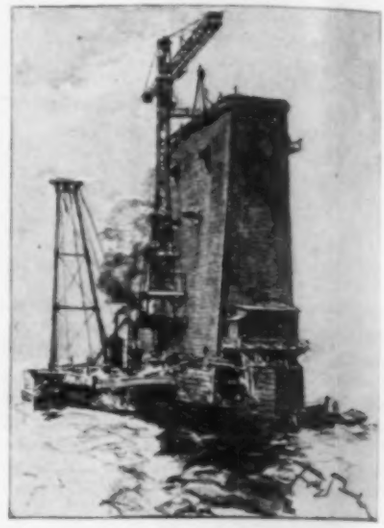
An original lithograph is reproduced on the page of special interest, the third page of this issue, depicting a cellular type of reinforced concrete caisson as it enters the water on a specially designed slipway. After launching, the caissons were inverted and floated into place and were located in final position by triangulation and direct measurement by copper wire.

Three other lithographs by the same artist are reproduced on this page. One shows the working platform of a pier on which are mounted two swing cranes and drill towers, plants for compressed air, and water pumps. By means of this equipment the 3-ft diameter pipes forming the sides of the caisson were excavated, thus sinking it to the proper depth. This proved to be a very satisfactory method since it was easy to straighten up a pier when it showed a tendency to sink unevenly. The straightening was done by ballasting one side and raising the other with jacks placed between the ceiling of the working chamber and the sea bottom.

One of the bridge piers is illustrated on this page. Each of the finished piers, of which there are four in all, weighs 60,000 tons and has a bottom area of 10,000 sq ft. The tallest pier has an overall height of 220 ft, being founded 25 ft below the sea bottom on a thick, impervious clay stratum.

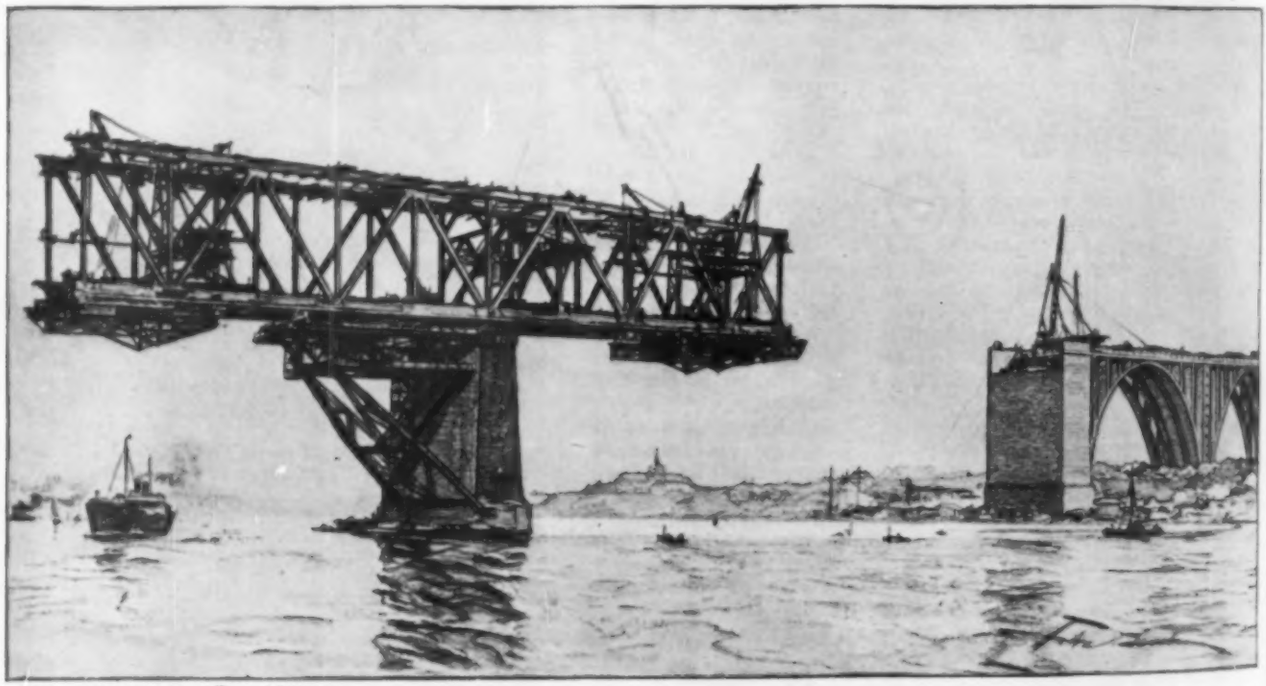
At the bottom of this page another illustration shows the first steps in constructing the bridge superstructure. The cantilever-type superstructure was used to satisfy the following conditions: (1) A vertical loading should cause a vertical reaction at the piers and any settlement in the piers should not cause stresses in the truss system. (2) The vertical clearance should be 108 ft. (3) The structure must be easy to erect without the use of scaffolding supported by piles or temporary piers. (4) No piers should be placed in the middle 650 ft of the strait and there should not be more than four piers. (5) The structure should harmonize with the low contours of the shores.

Reinforced concrete approaches of the arch-rib type, 100 ft high, can also be seen in the latter view. The approach at the Fyen end measures 454 ft, and that at



ONE OF THE FOUR PIERS COMPLETED

the Jutland end, 704 ft, making a total bridge length of 3,866 ft. The bridge design was proposed by engineers of the Danish State Railways, with certain modifications in caisson design by the contractor. The $5,900,000 project was completed this year and dedicated on May 14.



Lithographs furnished by Grüen and Bilfinger

FIRST STEPS IN ERECTING CANTILEVER STEEL SUPERSTRUCTURE
Part of Concrete Approach Appears at the Right

A Sinking Road Brought Under Control

By G. D. MORGAN

VIRGINIA MILITARY INSTITUTE STUDENT CHAPTER, LEXINGTON, VA.

This article is abstracted from an address by Mr. Morgan given at the Virginia Student Chapter Convention on April 6, 1935.

ANYONE who had occasion to drive from Richmond to West Point, by the Bottoms Bridge–New Kent road prior to about three years ago must have noticed the short stretch of unimproved road constituting the approach to the bridge over the Pamunkey River at West Point. The transformation wrought in this stretch since then is remarkable.

The approach extends eastward from the high ground in New Kent County to the bridge over the Pamunkey River, a distance of half a mile across a marsh. A creek classed as navigable ran through the marsh near the western edge and was spanned by a wooden arch bridge. The Pamunkey River crossing was a privately owned toll bridge, and since state maintenance of the road ended at the beginning of the approach, the latter was usually in bad condition. The Pamunkey being tidal at West Point, the road in spots was covered with water to a depth of two feet or more at times of very high tide.

OLD AUTOMOBILE FRAMES WERE PLACED ON ROADBED FOR ADDITIONAL WEIGHT

THE MARSHY SUBSOIL WAS FORCED UPWARD BY THE PRESSURE OF THE FILL

When the state took over the bridge in August 1933, the Highway Department abolished the toll and proceeded at once to put the approach in order. Two plans were proposed for this reconstruction. One was to drive piles along the entire length of the approach and build a road on top of the piles. The other was simply to put earth on the bed between the two bridges, build it up above the danger level from the highest expected tides and freshet waters, and after settling had ceased, to surface it. The latter plan was adopted after soundings made in the marsh indicated depths so great that the driving of piles was impracticable.

Work was started in September, and a large force of men and trucks hauled dirt from nearby borrow pits, dumping it on the roadbed and spreading it at once so that traffic was never actually stopped. As a result of the very low bearing capacity of the marsh soil, the whole stretch of roadway gradually sank from the weight of the earth placed on it, but the surface was continually brought back to the proper level with fresh material. At times, when a northeaster with its attendant rain and extremely high tides set in, the sinking was greatly accelerated. Overnight a drop of from 1 to 8 ft was not unusual, and the road force, which was constantly on the job, would have a difficult time making the stretch passable once more.

To increase the weight and hasten the settling near the center of the stretch, a temporary roadway of timber was laid at one side and the road itself was covered with old automobile bodies placed close together and bound with quantities of concrete. These also sank and were covered with more dirt, and the gradual sinking continued.

In the spring of 1935 a bottom of sorts was finally reached, and the Department prepared the roadbed for surfacing. The maximum fill required had been 70 ft deep.

A curious result of the immense weight of the earth placed on the roadway was that, as the solid road sank, the soft subsoil was pushed aside and forced upward until the surface of the marsh on either side of the roadway had risen in great mounds from 6 to 10 ft higher than the road surface. Then large cracks opened in the mounds, parallel to the road, and the soft plastic earth from below was forced up through them, curling over in great folds. These stand up in places to a height of from 5 to 8 ft, and the material, of a dark slaty color, has the appearance of peat.

At one time an explosion threw quite a scare into a truck driver and some motorists who happened to be near. It seems that on account of the lessening of pressure near the ground surface caused by these large cracks, marsh gas from the deep subsoil was released with such force that it tore a great hole in the shoulder of the road and scattered earth all about.

A WIDE, SMOOTH HIGHWAY NOW SPANS THE MARSH

When the job seemed to be near completion, sometime last fall, great quantities of the under soil were forced up into the bed of the creek near the western end of the approach, blocking the flow and dropping a section of the road. It was feared at first that, since the creek was classed as navigable, this influx of undersoil would have to be dredged out and the wooden bridge kept in place. However, a decision to the contrary was obtained, and the creek was filled to grade at this point and the bridge removed.

With the work completed, what was once a narrow, muddy road, at best a few inches above the reaches of an ordinary high tide, is a beautiful stretch of level highway half a mile long, 40 ft wide, and several feet above the reach of the highest possible tide. Grass is already growing on the shoulders.

NEWS OF ENGINEERS

From Correspondence and Society Files

LE ROY WILSON recently sailed for Brisbane, Australia, where he will be employed for several years on the construction of the new Jubilee Bridge.

F. HARPER CRADDOCK has taken a temporary position as engineer expert with the Federal Communications Commission for the special investigation of the American Telephone and Telegraph Company, with headquarters in Washington, D.C.

RUDOLPH P. MILLER was recently elected chairman of the American Standards Association Building Code Correlating Committee.

GROVER C. DILLMAN has just assumed the presidency of the Michigan College of Mining and Technology at Houghton, Mich. Mr. Dillman has for the past few years been in public service work in Lansing and Grand Rapids, Mich. He is a former state highway commissioner, a member and former president of the Michigan Engineering Society, and a member of the Detroit Engineering Society.

GROVER C. DILLMAN

THEODORE W. NORCROSS, chief engineer of the U. S. Forest Service, was awarded the honorary degree of master of science at Tufts College during the past commencement season.

GEORGE H. HENDERSON announces the formation of a consulting and engineering service at 14 Linden Avenue, Rumford, R.I.

VERNON A. C. GEVECKER, formerly a graduate assistant in the civil engineering department of the Missouri School of Mines, is now a graduate assistant in hydraulics at the California Institute of Technology in Pasadena, Calif.

CHARLES K. LEWIS has resigned as a junior accountant in the U. S. Forest Service to become district safety engineer for the U. S. Engineering Department, Los Angeles District.

HUBERT W. GREENE has resigned from the Construction and Maintenance Division of the Tennessee Valley Authority to accept a position with the State Highway Board of Georgia in the capacity of assistant resident engineer on construction. His headquarters are in Gibson, Ga.

MILO S. KETCHUM, JR., is with the Structural and Technical Bureau of the Portland Cement Association in Chicago, Ill. Prior to that he was a junior engineer for the U. S. Bureau of Reclamation in Denver, Colo.

ARTHUR J. TRAPP has been transferred from the position of assistant construction engineer in the Procurement Division of the Public Works Branch of the U. S. Treasury Department to that of project analyst in the Resettlement Administration of the same department. His headquarters have been changed from New York, N.Y., to Washington, D.C.

SHIRLEY T. CORFIELD, previously employed by the Peninsula Paving Company, of San Francisco, Calif., is now general superintendent of the Aqueduct Construction Company, of Desert Center, Calif.

FRANKLIN W. FISH has resigned as a construction foreman for the Metropolitan Water District of Southern California to become a dredging inspector for the Corps of Engineers, U. S. Army, with headquarters in San Pedro, Calif.

MENASHAH KOFMAN is now an assistant structural engineer for the Tennessee Valley Authority in Knoxville, Tenn. He was previously with the Electric Bond and Share Company, of New York, N.Y.

JOHN C. HABERER is at present employed in the bacteriological laboratory of the Consolidated Water Company of Utica, N.Y. He was formerly with the Linde Air Products Company of the same city.

HENRY A. YANCEY, who was city manager of Petersburg, Va., has taken a position in a similar capacity in Durham, N.C.

HARVEY S. HURLBURT is now chief of party for the Mason-Walsh-Atkinson-Kier Company on the construction of Grand Coulee Dam, with headquarters in Mason City, Wash.

H. HARVEY, of Petersfield, England, will be with the La Quaira Harbor Corporation Ltd., of La Quaira, Venezuela, until May 1936.

GEORGE A. SCHAEFER is with the Works Progress Administration in the capacity of supervisor of projects and planning of the New Haven (Conn.) district office.

A. H. HINKLE, research engineer for the Kentucky Rock Asphalt Company, has accepted an appointment to head the Kentucky Rock Asphalt Institute, recently organized by the rock-asphalt-producing companies of Kentucky. His headquarters are in Louisville, Ky.

R. R. TINKHAM, formerly superintendent of lighthouses in the 17th district with headquarters in Portland, Ore., has been made chief engineer of the U. S. Bureau of Lighthouses, with offices in Washington, D.C.

CLAUDE F. WERTZ has established a consulting sanitary engineering practice in Philadelphia, Pa., his office being at the southeast corner of Broad and Diamond streets. He is also Philadelphia representative of the Morse Boulger Destructor Company on heavy duty incineration.

Changes in Membership Grades

Additions, Transfers, Reinstatements, Deaths, and Resignations

From September 10 to October 9, 1935, Inclusive

ADDITIONS TO MEMBERSHIP

ALDERSON, ANTHONY DONALD (Jun. '35), Eng. Field Aide, U. S. Engr. Dept. (Res., 741 Grant St.), Iowa City, Iowa.

ALEWINE, JAMES K. (Jun. '35), Care, Hawley, Freese & Nichols, 407 Capps Bldg., Fort Worth, Tex.

ALLAN, ROBERT MYERS (Jun. '35), Engr., Standard Oil Co., Standard Oil Bldg. (Res., 1528 Sutter St.), San Francisco, Calif.

ALTVATER, RALPH LOUIS (Jun '35), With Schenectady County ERB; 2111 Grand Boulevard, Schenectady, N.Y.

ANDERSON, LOUIS HAROLD (Assoc. M. '35), Director of Public Utilities and Deputy City Engr. (Res., 2311 South Court), Palo Alto, Calif.

BENDEL, ROLAND (Assoc. M. '35), Div. Foreman, Alameda County Mosquito Abatement Dist.; Box 125 A, R.F.D., Niles, Calif.

BERRY, DONALD STILWELL (Jun. '35), With State Highway Dept., State Highway Laboratory, Ann Arbor, Mich.

BLANKENBURG, WILLIAM LUTHER (Jun. '35), 303 Smith Dormitory, Chapel Hill, N.C.

BLASCHKE, THEODORE OSCAR (Jun. '35), Designer, Platte Val. Public Power & Irrig. Dist. (Res., 1002 West 5th St.), North Platte, Nebr.

BLUM, LOUIS MENDEL (Jun. '35), Roosevelt Hotel, Grafton, W. Va.

BOYD, ALFRED DEWITTE (Assoc. M. '35), Civ. Engr. (Associate), U. S. War Dept.; 131 Claremont Ave., San Antonio, Tex.

BRACEY, SMITH HERBERT (Jun. '35), Junior Engr., State Highway Dept., Algood, Tenn.

BULLOCK, CARLOS DEWITT (Jun. '35), Designer, Platte Val. Public Power and Irrig. Dist. (Res., 734 South Jeffers St.), North Platte, Nebr.

BURKE, EDMUND MICHAEL (Assoc. M. '35), Regional Engr.-Insp., PWA, 2 Lafayette St, New York, N.Y.

CAMPBELL, WILLIAM JAMES (Jun. '35), With Wabash Ry., 117 North 3d St., St. Charles, Mo.

CHAMBERLIN, WILBUR HENRY (Jun. '35), Insp., Corps of Engrs., War Dept., Fort Peck Dist., 333 Francis St., Glasgow, Mont.

COOPER, IRVIN AARON (Jun. '35), 2060 McPherson St., North Bend, Ore.

COX, HAROLD EDWARD (Assoc. M. '35), With U.S. Geological Survey, Water Resources Branch (Res., 1292 Twenty-second Ave.), Columbus, Ohio.

CRUICKSHANK, DOUGLAS SPENCER (Jun. '35), 7216 Tenth Ave., Los Angeles, Calif.

DAVIES, WALTER GARFIELD (M. '35), Chf. Engr. Examiner for North Dakota, PWA, Care, Acting State Directors Office, PWA, Prince Hotel Bldg., Bismarck, N. Dak.

DOUGLAS, MALCOLM STEWART (Assoc. M. '35), Asst. Prof., Civ. Eng., Case School of Applied Science, Cleveland, Ohio.

DVORAK, JOHN JERRY (Jun. '35), Draftsman and Designer, Humble Oil & Refining Co., Baytown (Res., 6111 Washington Ave., Houston), Tex.

EGBERT, FORD (Jun. '35), 703 South 3d St., Temple, Tex.

FARENWALD, JOHN (M. '35), Chf. Estimator, Mc-

TOTAL MEMBERSHIP AS OF OCTOBER 9, 1935

Members	5,712
Associate Members	6,070
Corporate Members	11,782
Honorary Members	17
Juniors	2,952
Affiliates	96
Fellows	2
Total	14,849

CLINTIC-MARSHALL CORPORATION (Res., 1717 Elm St.), Bethlehem, Pa.

FLOOD, FRANK LEE (M. '35), Asst. Engr., Metcalf & Eddy, 1300 Statler Bldg., Boston (Res., 44 Stevens Rd., Needham), Mass.

FRAZIER, JOHN WARREN (Jun. '35), Rodman, State Highway Comm. (Res., 1815 Leavenworth St.), Manhattan, Kans.

FREEMAN, JOSEPH HINES (Assoc. M. '35), Civ. Engr., Grade 3, Los Angeles County Flood Control Dist.; 1845 Euclid Ave., San Marino, Calif.

FRIEDMAN, HAROLD JAMES (M. '35), Highway Engr., U. S. Bureau of Public Roads, Montgomery, Ala.

FRIEL, GILBERT MOIR (Jun. '35), Yard Asst., McClintic-Marshall Corporation (Res., 350 Thirty-Second Ave.), San Francisco, Calif.

GANO, WARDEN WARREN (Jun. '35), 333 North West 20th Ave., Portland, Ore.

GIANNINI, AMERIGO (Jun. '35), Junior Draftsman, State Highway Dept. (Res., 820 North 2d St.), Albuquerque, N. Mex.

GRAY, GEORGE REINHART (Jun. '35), 642 Ninth St., Oakmont, Pa.

HAFFERSON, HAROLD DONALD (Jun. '35), Lane, Idaho.

HAMILTON, DONALD MACKENZIE (Jun. '35), Student, Under Traveling Scholarship, Caird Trust, Dundee (Res., 14 Braidburn Terrace, Edinburgh), Scotland.

HAVAS, GEORGE (Assoc. M. '35), Care, Henry J. Kaiser Co., 1522 Latham Sq. Bldg., Oakland, Calif.

HOIDAL, CLARENCE RAYMOND (Jun. '35), Troy, Idaho.

HOUSNER, GEORGE WILLIAM (Jun. '35), 320 Buena Loma Court, Altadena, Calif.

HOWARD, GEORGE WILBERFORCE (Jun. '35), Junior Engr., U. S. Waterways Experiment Station (Res., Confederate Ave., Route 1, Box 179-B), Vicksburg, Miss.

KLEHS, HENRY JOHN WILHELM (Jun. '35), 2117 Pacific Ave., Alameda, Calif.

KLYCE, ERSKINE WATKINS (Jun. '35), Draftsman, Montana Water Conservation Board, Box 941, Helena, Mont.

KOCHIS, FRANK (Assoc. M. '35), Associate Engr., U. S. Engrs., 523 Pittock Blk., Portland, Ore.

LABATE, ANTHONY PETER (Jun. '35), Engr., Forestry Service, Box 13, Petersburg, Pa.

LAWSON, DAVID (Assoc. M. '35), Cons. Engr., 793 Broadway, New York, N.Y.

LEE, GEORGE ADDISON (Jun. '35), Junior Computer, U. S. A. Engr. Corps, Muskingum Conservancy Project (Res., 34 South 5th St.), Zanesville, Ohio.

LEVEROCK, SIDNEY CLEMENT (Jun. '35), Draftsman, Post & McCord, Inc., 101 Park Ave., New York (Res., 101–45 One Hundred and Fourteenth St., Richmond Hill), N.Y.

LUDWIG, JOHN HOWARD (Jun. '35), Chainman, Met. Water Dist. of Southern California; 923 Cabrillo Ave., San Pedro, Calif.

MCDERMOTT, JAMES REED (M. '35), Senior Highway Engr., Region 7, U. S. Forest Service (Res., 1705 Irving St., N.W.), Washington, D.C.

MCDONALD, EMMET JAMES (Jun. '35), 149 Watkins Ave., Bellevue, Pa.

MANSUR, CLINE LEE (Jun. '35), 746 De Barr, Norman, Okla.

MICHENER, PERCY ZELL (Assoc. M. '35), Asst. Highway Engr., Bureau of Bridges, State Div. of Highways (Res., 1800 Lowell Ave.), Springfield, Ill.

MITSCH, JOHN DONALD (Assoc. M. '35), Asst. Prof., Civ. Eng., Mass. Inst. of Tech., Cambridge, Mass.

MORAVEC, JAMES GUILFORD (Jun. '35), Engr., State Planning Board, Water Resources Hydraulics Laboratory (Res., 601 South Gilbert St.), Iowa City, Iowa.

MUSE, LEO JACKSON (Assoc. M. '35), Instr., Dept. of Civ. Eng., Louisiana State Univ. (Res., 340 Lafayette St.), Baton Rouge, La.

OGRAM, ALFRED (M. '35), Superv. Constr. Engr., U. S. Bureau of Prisons, Box 407, Chillicothe, Ohio.

PEABODY, DEAN, JR., (M. '35), Associate Prof., Mass. Inst. of Tech., Room 1–138, Mass. Inst. Tech., Cambridge, Mass.

PEAVEY, FRANK HARRIS (Jun. '35), Twin Falls, Idaho.

PENSO, LEONARD EDMOND (Jun. '35), Crestwood Pl., Great Neck, N.Y.

PEURIFOY, ROBERT LEROY (Assoc. M. '35), City Engr., City of Kingsville; Prof., Civ. Eng. and Director, School of Eng., Texas Coll. of Arts and Industries, Kingsville, Tex.

REED, CHARLES EMORY (Assoc. M. '35), With State Highway Comm. (Res., 625 Galisteo St.), Santa Fe, N.Mex.

ROTH, WILLIAM HUGH (Jun. '35), Junior Asst. Draftsman, State Highway Comm., 1110 Polk, Topeka, Kans.

RUGE, ARTHUR CLAUDE (Assoc. M. '35), Research Associate in Seismology, Dept., Civ. and San. Eng., Mass. Inst. Tech. (Res., 352 Harvard St.), Cambridge, Mass.

SEIM, MAYNARD CLIFFORD (Jun. '35), Insp., U. S. Engr. Dept. (Res., 4322 Belden Ave.), Chicago, Ill.

SHAPIRO, FREDERICK (Jun. '35), 482 Hancock St., Brooklyn, N.Y.

SHARRER, WILFRED HENRY (Jun. '35), 1 Bluff View, Chattanooga, Tenn.

SMITH, HENRY WILSON (Jun. '35), Signalman, Six Companies, Inc., General Delivery, Boulder City, Nev.

SPEER, PAUL RUDOLPH (Jun. '35), Box 948, Albany, N.Y.

STAUBACH, ARNOLD BALDWIN (Assoc. M. '35), Asst. Office Engr., State Highway Dept. (Res., 807-A Brazos St.), Austin, Tex.

STONEBURNER, CLIFTON GODFREY (Jun. '35), Box 42, Rosslyn, Va.

STORMS, RICHARD EDWARD (Jun. '35), 688 Lotus Ave., Oradell, N.J.

SVOBODA, GEORGE WESTBROOK (Jun. '35), Y. M. C. A., Hornell, N.Y.

SYKES, HORACE FENNELL, JR., (Jun. '35), Lieut., C.E., U.S.A., West Point, N.Y.

TAYLOR, DONALD WOOD (Assoc. M. '35), Research Asst., Soil Mechanics, Dept. of Civ. and San. Eng., Mass. Inst. Tech. (Res., 1 Crawford St.), Cambridge, Mass.

TRIMBLE, WILLIAM SCOTT (Assoc. M. '35), Sales Engr., W. C. Caye & Co. (Div. of Wilson-Weesner-Wilkinson Co.), 160 Walker St., Atlanta, Ga.

UNDERHILL, ALPHEUS FINCH (Assoc. M. '35), Engr., Southern Tier of New York, Portland Cement Co., Inc., Buffalo (Res., 351 Maple Ave., Elmira), N.Y.

VANDEGRIFT, LOUIS EDMOND (Assoc. M. '35), Field Engr., City of Columbus (Res., 361 East Hudson St.), Columbus, Ohio.

VOLLMAR, ALFRED GEORGE (Jun. '35), 11209 Eighty-fourth Ave., Richmond Hill, N.Y.

VON SCHOELER, WALDEMAR AUGUSTINE (Assoc. M. '35), 320 Noon St., Nogales, Ariz.

WITHEE, WARREN (Assoc. M. '35), Hydr. Engr., U. S. Geological Survey, Water Resources Branch, 217 Post Office Bldg., Chattanooga, Tenn.

MEMBERSHIP TRANSFERS

ADAMS, CLAUDE HARDY (Assoc. M. '27; M. '35), Vice-Pres. and Gen. Mgr., Adams Bros. Constr. Corporation, Rogers Bldg. (Res., 49 Sanford St.), Glens Falls, N.Y.

ALLEN, EDWARD RUSSELL (Jun. '29; Assoc. M. '35), Chf. Draftsman, The J. E. Greiner Co., 1201 St. Paul St., Baltimore (Res., West Joppa Rd., Towson), Md.

BAXTER, SAMUEL SERSON (Jun. '26; Assoc. M. '35), Asst. Engr., Bureau of Eng., Surveys and Zoning, City Hall Annex (Res., 5221 Horrocks St.), Philadelphia, Pa.

BROSELL, EDWARD SOLFRID (Jun. '31; Assoc. M. '35), Prin. Eng. Draftsman, TVA (Res., 605 West Clinch Ave.), Knoxville, Tenn.

BROWNING, ELMER LAWRENCE (Jun. '30; Assoc. M. '35), Engr. (Kenneth Markwell and Associates), 1903 Columbian Tower, Memphis, Tenn.

CHENEY, LAURENCE BRADFORD (Jun. '27; Assoc. M. '35), Regional Engr., State Projects, State Emergency Relief Administration, State Office Bldg., Hartford (Res., 43 Clifford St., Hamden), Conn.

DE FOREST, GEORGE PARMENTER (Jun. '28; Assoc. M. Sept. '35), 17 Myrtle Ave., Troy, N.Y.

EAST, LEWIS RONALD (Assoc. M. '27; M. '35), Commr., State Rivers and Water Supply Comm., Melbourne, Victoria, Australia.

GOUDEY, RAYMOND FREEMAN (Jun. '21; Assoc. M. '25; M. '35), San. Engr., Bureau of Water Works and Supply, Box 240, Arcade Annex, Los Angeles, Calif.

HERTENSTEIN, WESLEY (Jun. '26; Assoc. M. '35), Constr. Engr., California Inst. of Technology (Res., 247 South Vinedo Ave.), Pasadena, Calif.

HUNTER, HOMER ALEXANDER (Jun. '26; Assoc. M. '35), Office Engr. and Designer, Hawley, Freese & Nichols, 407 Capps Bldg., Fort Worth, Tex.

INGRAM, LON CARTWRIGHT, JR. (Jun. '29; Assoc. M. '35), Res. Engr., State Highway Dept., Box 771 (Res., 2412 Sixteenth St.), Lubbock, Tex.

JOHNSON, RUBEN CUMBY (Jun. '26; Assoc. M. '30; M. '35), Associate Prof., Civ. Eng., Univ. of South Carolina (Res., 614 Saluda Ave.), Columbia, S.C.

KERR, STANLEY ALBERT (Assoc. M. '12; M. '35), Associate Engr., with J. B. Lippincott, 543 Petroleum Securities Bldg., Los Angeles (Res., 141 East Spruce Ave., Inglewood), Calif.

KUEHNE, WALTER FREDERICK (Jun. '26; Assoc. M. '35), Contr. Engr., McClintic-Marshall Corporation, 1240 Telephone Bldg., St. Louis, Mo.

MASSMAN, HENRY JOSEPH, JR. (Jun. '28; Assoc. M. '35), Vice-Pres., Massman Constr. Co., 737 New York Life Bldg., Kansas City, Mo.

NEGROTTO, ALLEN JOSEPH (Assoc. M. '20; M. '35), Asst. State Engr., FERA (Res., 501 South Rendon St.), New Orleans, La.

NITTEBERG, CARL THEODORE (Assoc. M. '23; M. '35), Senior Highway Bridge Engr., U. S. Bureau of Public Roads, Dist. 6, 502 U. S. Court House, Fort Worth, Tex.

ORR, HAROLD RIPLEY (Jun. '27; Assoc. M. '35), Asst. Engr., U. S. Bureau of Reclamation (Res., 456 Washington St.), Denver, Colo.

PHELPS, ZIDA BENNETT, JR., (Jun. '28; Assoc. M. '35), Vice-Pres., Nussbaumer & Clarke, Inc., 514 Security Mutual Bldg., Binghamton, N.Y.

PICKETT, ARTHUR GORDON (Jun. '25; Assoc. M. '35), Civ. Engr. with Los Angeles County Surv., 700 Hall of Records, Los Angeles (Res., 152 Annandale Rd., Pasadena), Calif.

RISHELL, CHARLES GERALD (Jun. '31; Assoc. M. '35), Engr., Public Service Comm., Bureau of Eng., Harrisburg (Res., 2413 Market St., Camp Hill), Pa.

SHEIRY, EDWARD SLATER (Assoc. M. '29; M. '35), Prof. and Head, Civ. Eng. Dept., Robert Coll., Istanbul, Turkey.

SPAFFORD, HILDRETH ANCEL (Jun. '27; Assoc. M. '35), Asst. San. Engr., State Dept. of Public Health, Div. of San. Eng., Springfield, Ill.

SPLITSTONE, CHARLES HAROLD (Jun. '05; Assoc. M. '09; M. '35), Supt. of Constr., Erie R.R., Cleveland (Res., 2321 South Overlook Rd., Cleveland Heights), Ohio.

THOMAS, FRANCIS JOHN (Jun. '27; Assoc. M. '35), Asst. Engr., U. S. Bureau of Reclamation, Custom House, Denver, Colo.

TRIMBLE, RALPH MCCOY (Jun. '26; Assoc. M. '30; M. '35), Associate Prof., Civ. Eng., Univ. of North Carolina, Chapel Hill, N.C.

WELLS, CHARLES (Jun. '30; Assoc. M. '35), Junior Engr., Surface Waters Div., Water Resources Branch, U. S. Geological Survey, Topeka, Kans.

WILLIAMS, GEORGE DAVIS (Jun. '30; Assoc. M. '35), Asst. Res. Engr., State Highway Dept. (Res., 2505 Grand Ave.), Beaumont, Tex.

WING, CHARLES HEQUEMBOURG (Jun. '29; Assoc. M. '35), Gen. Constr. Contr. (Paris Constr. Co.), Brisbane Bldg. (Res., 592 West Ferry St.), Buffalo, N.Y.

WINTER, JOHN EVERETT (Jun. '32; Assoc. M. '35), Engr., Transbay Constr. Co., Mather, Calif.

WORKMAN, LEWIS JACOB (Jun. '33; Assoc. M. '35), Junior Engr., U. S. Bureau of Reclamation, 440 Custom House, Denver, Colo.

YATES, JOHN PERRY (Jun. '26; Assoc. M. '35), Res. Engr., Six Companies, Inc., Earp, Calif.

YOUNG, LAWRENCE RICHARD (Assoc. M. '27; M. '35), U. S. Engr. Office, Eastport, Me.

REINSTATEMENTS

EDGE, CLARENCE HOMER, Assoc. M., reinstated Oct. 2, 1935.

HENRY, MAXWELL, Assoc. M., reinstated Sept. 12, 1935.

KECKLER, JAMES PUMPHREY, Assoc. M., reinstated Sept. 12, 1935.

MCDONNELL, PORTER WILSON, Jun., reinstated Sept. 11, 1935.

MUHLHEIM, ARMIN, Assoc. M., reinstated Sept. 25, 1935.

ROONEY, WILLIAM FRANCIS, Assoc. M., reinstated Oct. 7, 1935.

STEPHENSON, JAMES, M., reinstated Sept. 9, 1935.

WALKER, JOHN FRAME, Assoc. M., reinstated Sept. 24, 1935.

RESIGNATIONS

KAEHRLE, MARTIN ALFRED, JR., Jun., resigned Sept. 11, 1935.

DEATHS

AIKEN, WILLIAM AUGUSTIN. Elected M. Oct. 2, 1889; died Oct. 5, 1935.

ALLEN, CHARLES KYES. Elected M. Oct. 31 1911; died July 14, 1935.

ATTERBURY, WILLIAM WALLACE. Elected M. March 2, 1909; died Sept. 20, 1935.

GLADDING, HENRY HOLBROOK. Elected Jun. July 1, 1885; M. Jan. 4, 1888; died Oct. 1, 1935.

GUTELIUS, FREDERICK PASSMORE. Elected M. Oct. 3, 1906; died Sept. 12, 1935.

HORNSBY, ROBERT WRIGHT. Elected M. Nov. 4, 1908; died July 16, 1933.

JORDAN, EDWARD CLARENCE. Elected M. May 7, 1890; died Sept. 15, 1935.

KENDRICK, JULIAN WAY. Elected M. Oct. 1, 1902; died Sept. 4, 1935.

ROUSSEAU, WILLIAM WHITE. Elected Assoc. M. Dec. 1, 1908; died Sept. 28, 1935.

SPERRY, EARL EUGENE. Elected M. Dec. 15, 1924; died Aug. 17, 1935.

STAGER, FREDERICK FRANK. Elected Jun. Mar. 12, 1918; Assoc. M. Dec. 14, 1924; died Aug. 23, 1935.

WOLFF, HANS HERMANN. Elected Assoc. M. Jan. 8, 1908; M. Sept. 5, 1911; died Oct. 1, 1935.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment of Members to Board of Direction

November 1, 1935 NUMBER 11

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years*	5 years of important work
Associate Member	Qualified to direct work	27 years	8 years*	1 year
Junior	Qualified for sub-professional work	20 years†	4 years*	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years*	5 years of important work
Fellow	Contributor to the permanent funds of the Society			

* Graduation from an engineering school of recognized reputation is equivalent to 4 years of active practice.

† Membership ceases at age of 33 unless transferred to higher grade.

The fact that applicants refer to certain members does not necessarily mean that such members endorse.

FOR ADMISSION

AHLF, AUGUST LOUIS, Logan, Utah. (Age 24.) Field Clerk, Inspection Div., PWA. Refers to T. C. Adams, E. B. Feldman, R. A. Hart, O. W. Israelsen, R. B. Ketchum.

ALLEN, ROBERT BENTON, Youngstown, Ohio. (Age 22.) Refers to T. C. Adams, F. M. Allen, R. B. Ketchum, M. S. Sanders.

ARENA, ANGELO THOMAS, Yonkers, N.Y. (Age 24.) Refers to A. Haring, C. T. Schwarze.

ASHLEY, JOSEPH DENSMORE EDWARD, Paxton, Ill. (Age 37.) County Engr. and Supt. of Highways, Ford County; City Engr., Paxton and Gibson City, Ill. Refers to H. E. Babbitt, S. E. Bates, G. A. Brown, R. F. Fisher, C. A. Petry.

ASHTON, NED LOWELL, Kansas City, Mo. (Age 32.) Chf. Designer, Ash, Howard, Needles & Tammen, Cons. Engrs. Refers to R. C. Gans, W. W. Horner, E. E. Howard, R. B. Kittredge, B. J. Lambert, J. L. Savage, B. W. Steele, H. C. Tammen, J. E. Vollmar.

BEPLAT, JAMES AUDEMARD, Flushing, N.Y. (Age 22.) Refers to F. O. X. McLoughlin, J. C. Rathbun, S. Wilmot.

BERRY, DAVID MAURICE, Berkeley Calif. (Age 28.) Senior Eng. Field Aid, California Div. of Highways, San Francisco-Oakland Bay Bridge, San Francisco, Calif. Refers to H. R. Church, S. M. Hands, I. L. Johnson, G. Mattis, E. Q. Sullivan, D. R. Warren, R. H. Wilson.

BLATT, JOSEPH DUV, New York City. (Age 22.) Refers to W. Allan, R. E. Goodwin.

BLATTLER, PAUL XAVER, Camden, N.J. (Age 34.) With Remington & Goff. Refers to W. A. Goff, M. den H. Kolyn, L. L. Langford, J. C. Remington, Jr., B. M. Schmucker.

BOOTH, DONALD ALFRED, Sewickley, Pa. (Age 22.) With Estimating Dept., Dravo Contr. Co., Neville Island Station, Pittsburgh, Pa. Refers to F. A. Barnes, S. C. Hollister, J. E. Perry, R. Y. Thatcher, C. L. Walker.

BROWN, BOYD SCOTT, Boulder, Colo. (Age 24.) Refers to F. R. Dungan, C. L. Eckel.

BUTLER, LEONARD JOHN, San Mateo, Calif. (Age 23.) Refers to E. S. Borgquist, F. C. Kelton, J. C. Park.

CAMBERN, THEODORE JESSUP, Kansas City, Mo. (Age 34.) Asst. Engr. (acting as Chf. Draftsman), Harrington & Cortelyou, Cons. Engrs. Refers to F. M. Cortelyou, J. L. Harrington, E. E. Howard, J. O. Jackson, H. C. Tammen, W. E. Wilbur, O. A. Zimmerman.

CARTER, VERNON LEE, Beloit, Kans. (Age 23.) Rodman, Kansas Highway Comm. Refers to L. B. Conrad, M. W. Furr, J. C. Riddell.

CHEN, CHAO WOO, Shanghai, China. (Age 24.) Refers to F. A. Barnes, B. A. Barrett, S. C. Hollister, J. E. Perry, F. J. Seery, L. C. Urquhart.

CONWELL, WILLIAM ANTHONY, Pittsburgh, Pa. (Age 27.) Designer, Allegheny County Authority. Refers to E. H. Anson, F. J. Evans, B. T. Gordon, J. F. Leonard, F. M. McCullough, J. E. C. Powell, A. A. Pregler, G. S. Richardson, C. B. Stanton, H. A. Thomas.

CORNELIUS, WILLIAM PASCAL, Sherman, Tex. (Age 25.) Instrumentman, Texas Highway Dept. Refers to C. C. Cagle, F. M. Davis, H. H. Peel, J. E. Pirie.

DAY, GORDON, Englewood, N.J. (Age 23.) Refers to J. B. Babcock, 3rd, C. B. Breed, R. W. Greenlaw, J. W. Howard.

DEARSTYNE, SAMUEL CHARLES, Long Beach, Calif. (Age 36.) Structural Designer, Harbor Dept., City of Long Beach, Calif. Refers to B. L. Craig, R. J. Kadow, F. B. Laverty, W. E. Wilson, W. T. Wright.

DEWEY, BYRON NELLIS, New York City. (Age 23.) Refers to T. R. Lawson, H. O. Sharp.

DODGE, ELDON RAYMOND, Cleveland, Ohio. (Age 25.) Instructor in Civil Engineering, Case School of Applied Science. Refers to G. E. Barnes, F. M. Dawson, M. S. Douglas, L. F. Van Hagan.

FARRELL, GEORGE WESLEY, Hannibal, Mo. (Age 36.) City Engr. Refers to E. B. Black, J. F. Brown, H. E. Frech, F. M. Veatch, N. T. Veatch, Jr., R. M. Willis.

FITCH, HORATIO MAY, Fargo, N.Dak. (Age 34.) Instructor in Civ. Eng., North Dakota Agricultural Coll. Refers to M. L. Enger, R. P. Hoelscher, W. C. Huntington, H. H. Jordan, W. E. Smith, C. C. Wiley.

GRUETER, PAUL CHARLES, Brighton, Mass. (Age 25.) Tech. Asst., Massachusetts Inst. of Technology, on Cape Cod Canal Research for U. S. Engr. Dept., Boston, Mass. Refers to J. B. Babcock, 3rd, C. B. Breed, W. M. Fife, J. L. Howard, K. C. Reynolds.

HAASE, ROBERT RALPH, New Orleans, La. (Age 23.) Refers to D. Derickson, W. B. Gregory.

HANSON, THOMAS COOPER, Detroit, Mich. (Age 29.) Instructor in Civ. Eng., Univ. of Detroit. Refers to P. G. Brown, E. L. Eriksen, G. P. Springer, R. B. Wiley.

HAYES, JOHN MARION, Bean Station, Tenn. (Age 26.) Under Eng. Aide, Highway Sec., Gen. Eng. Div., TVA, Knoxville, Tenn. Refers to G. P. Springer, R. B. Wiley.

HELMICH, DANIEL ANDREW, Birmingham, Ala. (Age 40.) Asst. Engr., Jefferson County Highway Dept. Refers to W. H. Caruthers, A. C. Decker, W. Finnell, H. H. Hendon, H. H. Houk, C. J. Rogers, W. G. Stromquist.

JONES, RICHARD ALLEN, White Plains, N.Y. (Age 34.) Engr., Grade E, Westchester County Emergency Work Bureau. Refers to A. M. Anderson, T. A. Avery, J. Downer, C. A. Garfield, L. G. Holleran, C. MacDonald, T. M. Ripley, D. D. Thomson.

JOHNSTON, ROBERT COSSIN, New York City. (Age 22.) Refers to G. E. Beggs, F. A. Heacock.

JONES, PAUL AGNEW, Boulder City, Nev. (Age 49.) Associate Engr., and Chf. Inspector of Boulder Dam, U. S. Bureau of Reclamation. Refers to F. T. Crowe. H. D. Newell, R. J. Newell, W. A. Perkins, J. L. Savage, B. W. Steele, W. R. Young.

KAPLAN, HYMAN, New York City. (Age 22.) Refers to R. C. Brumfield, F. E. Foss, G. Morrison.

KENNY, JAMES STEPHEN, Forest Hills, N.Y. (Age 31.) Asst. Engr., Floyd Bennett Airport, Dept. of Docks, City of New York. Refers to L. E. Andrews, W. T. Doran, C. B. Galvin, H. C. Paddock, J. Tarnay, A. S. Toth, W. H. Yates.

KIKER, JOHN EWING, Jr., Boston, Mass. (Age 29.) Refers to T. R. Camp, R. S. Charles, W. M. Fife, W. I. Klein, G. E. Russell.

LAMBERT, JOHN WILLIAM, Columbus, Ohio. (Age 28.) Refers to G. E. Large, J. M. Montz, C. T. Morris, C. E. Sherman, R. C. Sloane.

LIEBSCHER, ARTHUR FRANK, Oakland, Calif. (Age 22.) Inspector of Constr., Outer Harbor Terminal, Port of Oakland. Refers to R. E. Davis, C. Derleth, Jr., H. D. Dewell, B. A. Etcheverry, S. T. Harding, B. Jameyson.

MACKENZIE, WILLIAM BIGELOW, Springfield, Mo. (Age 35.) Asst. Bridge Engr., St. Louis-San Francisco Ry. Refers to R. D. French, F. D. Hughes, F. G. Jonah, J. B. Neely, L. A. Weeks.

MCCOSH, STANLEY ARMSTRONG, Denver, Colo. (Age 36.) Asst. Prof. of Civ. Eng., Colorado School of Mines, Golden, Colo. Refers to R. L. Downing, J. C. Fitterer, A. H. Fuller, J. T. L. McNew, J. J. Richey.

MAHONE, JOHN THOMAS, McAllen, Tex. (Age 25.) Planning Engr., Soil Conservation Service (ECW). Refers to R. W. Briggs, E. B. Darby, B. A. Greene, J. Q. A. Greene, W. W. Hall.

MARANE, ALFRED CARL, Chattanooga, Tenn. (Age 28.) Eng. Draftsman, TVA. Refers to H. P. Hammond, L. F. Rader.

MECREDY, HENRY EDWARDS, Bristol, Va. (Age 52.) Dist. Director, WPA of Virginia, Sixth Dist., Administrative work. Refers to J. A. Anderson, M. A. Butler, T. Ellett, A. W. Harman, W. W. McClevy, C. W. Ogden.

MEMORY, DUNCAN THOMAS, Cumberland, Gap, Tenn. (Age 37.) With TVA as Office Engr. (Executive Asst.) at Tazewell, Tenn. Refers to J. L. Becton, J. A. Higgs, Jr., J. W. Marks, C. C. Muhs, G. P. Stowitts, H. A. Wiersema.

MILLER, CYRIL JOSEPH, Ames, Iowa. (Age 21.) Designing Engr., Iowa State Coll. Refers to R. A. Caughey, A. H. Fuller, W. E. Galligan, F. Kerekes, L. O. Stewart.

MILLER, RAYMOND VERNON, Brooklyn, N.Y. (Age 42.) Lt. Comdr., Civ. Eng. Corps, U. S. Navy; Asst. Public Works Officer, Navy Yard, New York City. Refers to W. H. Allen, W. M. Angas, R. E. Bakenhus, W. Bowie, A. L. Parsons, G. T. Rude.

MOORE, JAMES WILBUR, Corning, N.Y. (Age 23.) Refers to J. C. Prior, J. R. Shank, C. E. Sherman, R. C. Sloane.

MORRIS, ROBERT BEVERLY, Asheville, N.C. (Age 30.) Jun. Civ. Engr., U. S. Forest Service. Refers to S. A. Becker, A. Dana, R. J. Fogg, M. O. Fuller, C. L. Mann, H. Tucker, W. L. Wilson.

OAKEY, JOHN ARTHUR, New York City. (Age 30.) Instructor, in highway and railroad engineering, engineering economics and surveying, Civ. Eng. Dept., Columbia Univ. Refers to A. H. Beyer, D. M. Burmister, F. M. Dawson J. K. Finch, W. J. Krefeld, D. W. Mead.

PINE, CHARLES ADAM, Kansas City, Mo. (Age 29.) Res. Engr. with Charles A. Haskins, Cons. Engr. Refers to L. E. Conrad, F. F Frazier, T. R. Haseltine, C. A. Haskins, R. O. Ruble, C. L. Wade, L. V. White.

QUILTY, THOMAS PATRICK, New York City. (Age 24.) Refers to A. H. Beyer, J. K. Finch, W. J. Krefeld.

REED, EDWARD OSKIN, Dormont, Pa. (Age 36.) Engr., Allegheny County Authority, Pittsburgh, Pa. Refers to R. W. Burpee, V. R. Covell, H. K. Dodge, S. Eckels, R. S. Quick, J. M. Rice, G. S. Richardson, S. A. Shubin, J. D. Stevenson.

RIGGS, CHARLES EDWARD, Oakland, Calif. (Age 30.) Field Engr., Joint Highway Dist. No. 13, State of California. Refers to J. F. Barber, W. B. Boggs, H. B. Campbell, M. C. Collins, A. S. Gelston.

ROBINSON, GEORGE VINTON, Portland, Ore. (Age 41.) Engr. with Baar & Cunningham, Cons. Engrs. Refers to J. W. Cunningham, V. Gongwer, G. Kimbrell, R. E. Koon, C. B. McCullough, H. A. Rands, E. C. Willard.

ROHRER, GEORGE HILLDRING, Mt. Lakes, N.J. (Age 31.) Refers to R. M. Beck, D. C. N. Collins, H. R. Gabriel, H. Hartwell, S. Johannesson, E. B. Karnopp.

ROUSE, HUNTER, New York City. (Age 29.) Instructor in Civ. Eng., Columbia Univ. Refers to B. A. Bakhmeteff, C. B. Breed, J. K. Finch, G. E. Russell, C. M. Spofford, C. H. Sutherland, J. B. Wilbur.

RUSSELL, ALEXANDER DAVID, Berkeley, Calif. (Age 24.) Refers to C. Derleth, Jr., B. A. Etcheverry, C. G. Hyde, A. A. M. Russell, H. E. Squire, F. G. White.

SWANSON, VICTOR GEORGE, Parkville, Vic., Australia. (Age 25.) Designing Draftsman, State Rivers and Water-Supply Comm. of Victoria, Melbourne. Refers to R. R. B. Bennett, H. Conradi, L. R. East, W. M. Pullar, C. W. N. Sexton.

TAPMAN, GLADYCE (Miss) Brooklyn, N.Y. (Age 23.) Refers to F. A. Barnes, E. N. Burrows, J. Meltzer, G. Paaswell, J. E. Perry, R. Y. Thatcher, P. H. Underwood, C. L. Walker.

VAN ATTA, FRED FOSTER, Paducah, Ky. (Age 23.) Under Eng. Aide, TVA. Refers to C. L. Allen, C. M. Cade, C. A. Miller, L. J. Rothgery.

VAN HORN, ROBERT BOWMAN, Seattle, Wash. (Age 42.) Associate Prof. of Civ. Eng., Univ. of Washington. Refers to C. W. Harris, R. M. Harris, G. B. Hawthorn, F. A. Kittredge, C. C. May, C. C. More, R. G. Tyler.

VAUGHAN, CHARLES ASHBY, San Francisco, Calif. (Age 51.) Refers to J. F. Beaman, H. S. Comly G. L. McLane, H. K. Ward, G. G. Wickline.

WHITEHEAD, WILLIAM JAMES, Cleveland, Ohio. (Age 27.) Refers to G. E. Barnes, M. S. Douglas, G. B. Earnest, F. L. Plummer, W. E. Rice.

ZEHETNER, FRANCIS CHARLES, New York City. (Age 32.) Prof. of Eng. Mechanics and Head of Dept. of Eng. Mechanics, Manhattan Coll. Refers to J. J. Costa, F. A. O'Hare, A. V. Sheridan, E. J. Squire, D. S. Trowbridge.

FOR TRANSFER

FROM THE GRADE OF ASSOCIATE MEMBER

ALLEN, HAROLD JOSEPH, Assoc. M., Corozal, Canal Zone. (Elected May 25, 1931.) (Age 41.) Associate Engr., U. S. Engr. Office, Chf. of Operations Div., Corozal, Canal Zone. Refers to J. E. Bebb, J. H. Cissel, L. M. Gram, W. C. Hoad, M. J. Quinn.

RAAB, NORMAN CECIL, Assoc. M., San Francisco, Calif. (Elected Junior June 19, 1902; Assoc. M. Nov. 15, 1926.) (Age 40.) Superv. Bridge Designing Engr., San Francisco–Oakland Bay Bridge. Refers to C. E. Andrew, G. E. Beggs, F. W. Panhorst, E. J. Schneider, F. C. Scobey, H. E. Warrington, G. B. Woodruff.

REED, ROYDEN EUGENE, Assoc. M., Topeka, Kans. (Elected August 26, 1929.) (Age 41.) State Engr.-Inspector, Kansas and Oklahoma, PWA. Refers to B. Boyle, J. W. Childs, L. S. Dixon, F. O. Dufour, F. E. Everett, R. S. Holmgren, R. E. Lawrence, R. R. Marsden, P. A. Shaw, G. G. Shedd.

SAGER, GEORGE HENRY, Jr., Assoc. M., Louisville, Ky. (Elected Aug. 29., 1927.) State Director, PWA, Louisville for FEA of PW. Refers to G. H. Davis, L. H. Davis, F. C. Dugan, O. M. Jones, A. C. Knight, L. E. Loxley, W. E. Swift, F. J. Trelease, P. A. Trost, J. S. Watkins.

FROM THE GRADE OF JUNIOR

ANCKAITIS, VICTOR WILLIAM, Jun., Easton, Pa. (Elected July 16, 1928.) (Age 32.) Borough Engr., Wilson, Pa.; Asst. Supt., Northampton County, Pennsylvania Dept. of Highways; also private practice. Refers to C. H. Buckius, F. O. Dufour, R. L. Fox, M. O. Fuller, W. S. Lohr, J. McNeal, L. Perry, P. P. Rice, H. T. Rights, E. H. Rockwell, C. E. Tilton.

BECKWITH, CHARLES SEWARD, Jun., Endicott, N.Y. (Elected Oct. 1, 1928.) (Age 31.) Chf. Draftsman and Mech. Designer, Endicott Johnson Shoe Corporation. Refers to G. H. Elbin, J. A. Giles, H. L. Jacot, H. T. Ware, A. R. Webb.

BERRY, CARL MORRISON, Jun., Davenport, Wash. (Elected Aug. 17, 1931.) (Age 31.) Geodetic and Cadastral Engr., Chf. of Party, U. S. Bureau of Reclamation, Coulee Dam, Wash.

Refers to F. A. Banks, E. L. Greene, O. H. Hallberg, J. H. Miner, G. L. Parker, L. P. Raynor, W. J. Ryan.

BRUCK, HENRY HANS, Jun., San Francisco, Calif. (Elected Nov. 10, 1930.) (Age 32.) Concrete Technician, Golden Gate Bridge and Highway Dist. Refers to R. G. Cone, C. Derleth, Jr., T. W. Espy, W. B. Gester, C. G. Hyde, F. M. Randlett.

CROWELL, SIDNEY HOWE, Jun., Huntington, W. Va. (Elected June 4, 1928.) (Age 32.) Jun. Engr., U. S. Engr. Office. Refers to F. Bass, A. S. Cutler, C. C. Fishburn, F. L. Peacock, E. E. Teeter, W. S. Winn.

GOLDBERGER, HAROLD WILLIAM, Jun., Astoria, N.Y. (Elected July 25, 1932.) (Age 30.) Constr. Engr., Cornell Contr. Corporation, New York City. Refers to J. H. C. Gregg, L. S. Joseph, C. M. Madden, L. C. Pope, M. T. Staples, F. W. Stiefel.

IVANCICH, PAUL NICHOLAS, Jun. (Elected Oct. 10, 1927.) Ft. Worth, Tex. (Age 33.) Commanding Officer, CCC Camp SP-36-T, Brownwood, Tex. Refers to R. J. Cummins, C. R. Haile, A. B. Miller, P. D. Simpson, C. M. Spofford.

LANDON, RANSOM DURELL, Jun., Dallas, Tex. (Elected March 30, 1931.) (Age 32.) Associate Prof., School of Eng., Southern Methodist Univ. Refers to J. H. Brillhart, O. N. Floyd, J. H. Knox, H. B. Luther, W. H. Meier, E. L. Myers, E. N. Noyes.

NIEMEN, ELMER JACOB, Jun., Coulee Dam, Wash. (Elected Oct. 14, 1930.) (Age 32.) Associate Engr. on Coulee Dam for U. S. Bureau of Reclamation. Refers to O. A. Abelson, F. A. Banks, V. Gongwer, E. L. Greene, J. H. Miner, V. R. Rathbun, F. J. Sharkey, B. E. Torpen.

PEARSON, ARTHUR SEYMORE, Jun., Yonkers, N.Y. (Elected Oct. 14, 1930.) (Age 30.) Inspector, Civ. Eng. Dept., New York Edison Co., New York City. Refers to W. H. Dieck, K. E. G. Eliasson, J. Farhi, R. L. Sands, E. M. Van Norden.

POTTER, SEYMOUR AUSTIN, Jr., Jun., Belleville N.J. (Elected Oct. 29, 1934.) (Age 27.) Transitman, M. of W. Dept., Erie R.R. Co., Jersey City, N.J. Refers to A. J. Boase, H. N. Halper, R. Hoffmann, H. M. Shepard, C. H. Splitstone.

SEDGWICK, GEORGE ARTHUR, Jun., Sacramento, Calif. (Elected Oct. 10, 1927.) (Age 32.) Asst. Bridge Designing Engr., Div. of Highways, California Dept. of Public Works. Refers to J. Gallagher, H. E. Kuphal, A. W. Nordwell, F. W. Panhorst, H. B. Squire, F. G. White.

SOROKA, MARY OLGA (Miss), Jun., Baltimore, Md. (Elected March 14, 1927.) (Age 30.) Chf. Engr., Air Devices Corporation. Refers to H. T. Campion, T. B. Parker, C. M. Spofford, G. R. Strandberg, L. White, D. M. Wood.

STEVENSON, HOMER EADS MACGREGOR, Jun., Llano, Tex. (Elected Dec. 5, 1927.) (Age 32.) Res. Engr., Texas State Highway Dept. Refers to P. Baumann, H. D. Chapman, G. R. G. Conway, W. S. Post, W. B. Simpson, H. F. Stubbs, S. A. Thomas, Jr., G. G. Wickline.

WANDERER, HENRY GEORGE, Jun., Spring Valley, N.Y. (Elected Aug. 27, 1928.) (Age 33.) Asst. Dist. Engr., CWA and TERA of New York State, Rockland and Westchester Counties. Refers to C. A. Gridley, R. S. Moore, C. H. Nichols, A. Noack, R. T. Robinson, A. M. Wyman, F. C. Zeigler.

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 87 of the 1935 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

CONSTRUCTION

CONSTRUCTION ENGINEER; Jun. Am. Soc. C.E.; 32; married; BS. in C.E., New York University; enrolled Alexander Hamilton Institute business course; 5 years as contractor's engineer on costs and construction, bridges, roads, bulkheads, foundations; 4 years with telephone company, engineer in charge on 50 miles of conduit construction and 35 miles of conduit rearrangements. Desires reponsible position with future. C-5622.

CONSTRUCTION ENGINEER AND CONTRACTOR; M. Am. Soc. C.E.; age 54; desires position with executive responsibility on hydro-electric development, dams, municipal improvements, paving, bridges, heavy excavation, and grading. Over 30 years in responsible charge of design and construction of important works, with thorough knowledge of economical methods of cost and efficient management. A-4827.

ENGINEER AND SUPERINTENDENT; Assoc. M. Am. Soc. C.E.; graduate C.E.; 36; 16 years experience general construction; and supervised construction of hospitals, hotels, theaters, office buildings. Desires employment with contractor or corporation. Location immaterial. B-5434.

DESIGN

STRUCTURAL ENGINEER; M. Am. Soc. C.E.; thoroughly experienced in planning industrial buildings and in structural designs for architects. Experience covers 20 years of work on designs of various types and sizes of buildings. Desires connection in or near New York City. B-929.

EXECUTIVE

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 34; married; 6 years experience in all phases of highway location and construction; 1 year on railroad location; 3½ years as chief of party on flood control, plane table, and precise leveling surveys. Desires responsible position with future. Available on two weeks notice. Location, United States. D-4385-359-A-4 San Francisco.

ENGINEERING EDITOR, OR ASSISTANT; M. Am. Soc. C.E.; university graduate; structural, concrete, and consulting engineer; 18 years experience; author of engineering articles; past 12 years editor Western general magazine; experience all phases editorial work, editorial writing, print shop supervision. Position wanted as editorial assistant on technical magazine. Any reasonable offer considered. Will go anywhere. D-4390.

SANITARY ENGINEER; Assoc. M. Am. Soc. C.E.; graduate civil engineer; 13 years experience in the design and construction of sewage treatment plants and sewers; for the past two years has specialized in chemical-type sewage-treatment plants; will be available on reasonable notice. C-874.

STRUCTURAL ENGINEER; M. Am. Soc. C.E.; Pennsylvania registration; with fabrication and construction business for over 20 years. Supervision of engineering, sales, and plant operations. Also district representative, western Pennsylvania and Ohio. Available immediately. C-5095.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 28; married; B.S., U. S. Military Academy, 1928; C.E., 1932; M.C.E., Cornell University; experience covers topographic surveys, hydrographic surveys, economic studies of waterways, flood control studies, hydraulic research, river improvement; particularly interested in hydraulic research. Desires permanent position. Location temperate zone. Available immediately. D-4234.

ENGINEER; Assoc. M. Am. Soc. C.E.; 29; married; B.S., Carnegie Institute of Technology; 8 years experience with public utility in hydro-electric investigations, electrical distribution engineering, cost analysis, appraisals, and estimating. Also teaching experience in mathematics. Capable of directing engineering investigations. Available on short notice. D-1157.

JUNIOR

CIVIL ENGINEER; Jun. Am. Soc. C.E.; single; B.S. in C.E., 1933; majored in structural steel design and water supply. Experience water and sewage works; geodetic survey. Desires opportunity in any branch civil engineering. Location immaterial. Available on short notice. D-2683.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; single; 23; B.S. in C.E., Georgia School of Technology, 1934; 2½ years experience, all types of surveying instruments; 3 months with U. S. Geological Survey, aerial photomapping project; 14 months as transitman with U. S. Coast and Geodetic Survey, with local control surveys. Can handle men. Good knowledge of scientific French. Desires opportunity; initial salary and location secondary. Available short notice. D-4344.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 25; Polytechnic Institute of Brooklyn, 1932; 3 years experience in building construction—2 as contractor's engineer in charge of engineering work, 1 as assistant engineer on construction of 30 state buildings at Orangeburg, Creedmoor, Wingdale, N.Y.—1 year experience in design of steel reinforced concrete structures—buildings, retaining walls, storm-water systems, etc. Location immaterial. D-2386.

RECENT C.E. GRADUATE; Jun. Am. Soc. C.E.; some practical construction experience; good draftsman and structural steel designer; good personality; excellent recommendations; owns car; married; willing to travel anywhere within the United States. Looking for opportunity offering moderate salary and possibilities of advancement. D-4275.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 24; single; B.S. in C.E., North Dakota State College, 1934; 1 year experience on highway construction; 5 months on cadastral surveys. Desires work on highway construction, irrigation, or water conservation. Available on two weeks' notice. Location immaterial. D-4370-359-A-3 San Francisco.

ENGINEER; Jun. Am. Soc. C.E.; A.B., Yale University, 1928; B.S., Sheffield Scientific School, 1930; civil engineer—majored in building construction; layout engineer on reinforced concrete industrial building. Experience in state highway department: 1 year general surveying, 2 years drafting and designing. Checker of plans, specifications, and estimates. Desires position with opportunity. Available. D-4318.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 23; married; B.S. and M.S. in C.E., University of